Macintosh Computers
Vol. I

Service Guide

Compact & Portable Computers
March 1993

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Introduction

This March 1993 update to volumes 1 and 2 of the *Apple Service Guide for Macintosh Computers* replaces the previous version of the guides. For this update we made the following additions and revisions:

- Volume 1 covers all compact and portable Macintosh® computers—that is, all Macintosh computers that do not require an external monitor.
- Volume 2 covers all modular Macintosh computers.
- The guides are slightly larger (8.5 inches by 5.5 inches) than the previous versions.
- This release contains documentation on 13 additional computers.

Organization

Volume 1 of the *Apple Service Guide for Macintosh Computers* contains service and repair information for the following computers:

- Macintosh 128K, 512K, 512K enhanced, and Plus
- Macintosh SE and SE/30
- Macintosh Classic®, Classic II, and Performa™ 200
- Macintosh Portable
- Macintosh PowerBook™ 100, 140, 145, 160, 170, and 180
- Macintosh PowerBook Duo™ 210, Duo 230, Duo Dock, and Duo MiniDock

Volume 2 of the *Apple Service Guide for Macintosh Computers* contains service and repair information for the following computers:

- Macintosh LC, LC II, and Performa 400
- Macintosh II, IIx, and IIfx
- Macintosh IIcx, IIci, and IIsi
- Macintosh IIvx, IIvi, and Performa 600
- Macintosh Quadra™ 700, 900, and 950

Each volume also contains a SIMM chart for the products covered by that volume and information on ADB devices, module symptom codes, diagnostics, ports, cables, and pinouts.

Using the Guide

Important   When ordering a replacement module or spare part, be sure to check the part number given in the guide against the current price pages in *Service Source*. Remember that the *Apple Service Guide* is not updated on a regular basis.

Ten Rules to CRT Safety

1. Do not work on a monitor alone. In case of an accident, having someone nearby—and having someone trained in CPR—could save your life.

2. Remove all jewelry before performing repairs on a CRT. Removing these conductors reduces the possibility of electric shock.

3. Never use a grounding wriststrap or heelstrap or work on a grounded workbench mat when discharging a monitor or when performing live adjustments. Grounding straps and mats are used to protect sensitive components from ESD damage and should be used only when working on "dead" (uncharged) equipment.

4. Wear safety goggles when working with a CRT. The CRT contains a high vacuum. If cracked or broken, the CRT can implode (collapse into itself). To protect your eyes, always wear safety goggles.

5. Before working inside a monitor, turn off the power and disconnect the AC power cord. Certain parts of a monitor chassis are live (electrified) when the monitor is under power. Never work on a monitor under power except when making live adjustments.

6. Keep one hand in your pocket or behind your back when working on a live monitor. This reduces the risk of current passing through your body, should you accidentally contact high voltage.

7. Always discharge the anode before touching anything inside the monitor. High voltage (up to 12,000 volts DC) can be present on the anode and other components—even when power is off.

8. Never touch the anode connector or the anode aperture. When a CRT is replaced, the anode connector is removed, exposing the anode. The anode can retain a charge of several thousand volts even when power is off and can regain some charge even after being discharged.

9. Do not pick up or handle a CRT by its neck (see Figure 1). To prevent an implosion, take every precaution against breaking the tube. Be especially careful with the neck, where the tube is thinnest.

10. In addition, never touch the following components (see Figure 1) when adjusting a live Macintosh CRT:
    - Back of the power switch
    - Yoke wires
    - Anode connector
    - Anode wire
    - Flyback transformer

Figure 1   CRT High-Voltage Areas

Figure 2   Discharging the CRT

Safety Warnings

▲ **Warning**   The compact Macintosh computers contain high voltage and a high-vacuum picture tube. To prevent serious personal injury and property damage, make sure you read and understand the safety precautions in this section.

▲ **Warning**   Voltage and video adjustments are performed with the power on. Review the cathode-ray tube (CRT) safety and live adjustment rules before performing these adjustments.

▲ **Warning**   Failure to follow the rules for safe CRT discharge could result in serious injury or property damage. For compact Macintosh computers, the CRT must be discharged to the ground lug to prevent damage to the logic board.

▲ **Warning**   Make sure that you are not grounded when:
   • You work on plugged-in equipment
   • You discharge a cathode-ray tube (CRT)
   • You work on an unplugged CRT that has not been discharged
   • You perform live adjustments

▲ **Warning**   Electrostatic discharge (ESD) can cause severe damage to sensitive microcircuits. Macintosh circuit boards contain CMOS components, among the most sensitive chips in use today. CMOS chips, ROMs, and SIMMs are very susceptible to ESD and skin acid damage. To prevent damage to these components, handle them only by the edges.

▲ **Warning**   A "dead" lithium battery is considered hazardous waste and has some potential for explosion if improperly handled. Mark the battery *DEAD*, place it in a zip-locked wrapper and the packaging used to ship the replacement battery. Return the dead battery to Apple®, where it will be disposed of following EPA guidelines. Exception: If the battery is physically damaged, do not return it to Apple; dispose of the battery locally according to local ordinances.

Discharging and Devacuuming the CRT

Use the following procedure to discharge high voltage (12,000 volts) from the picture tube of a compact Macintosh. This procedure and the CRT discharge tool (see "Special Tools Index" in the General Information section) can be used to discharge any Macintosh monitor.

▲ **Warning**   **Discharge the anode to the metal ground lug (see Figure 2). Failure to do so may damage the logic board.**

Discharge Procedure

1.   Remove your grounding wriststrap and jewelry, and put on safety goggles.
2.   Attach the alligator clip on the CRT discharge tool to the metal part of the ground lug (see Figure 2).
3.   Put one hand in your pocket or behind your back. With your other hand, insert the tip of the CRT discharge tool under the anode cap until it touches the anode ring.
4.   Remove the CRT discharge tool. To be sure the CRT is discharged, repeat the discharge procedure (you may want to repeat the procedure using a flat-blade screwdriver with an insulated handle).

Note   The anode can build up voltage over time. To drain off any residual charges, establish an ongoing ground. Fasten one end of an alligator lead to the ground lug and the other end to the anode aperture.

Disposing of the Cathode-Ray Tube (CRT)

To prevent serious injury, follow the procedure described in this section whenever discarding a CRT.

▲ **Warning**   **To properly dispose of a defective CRT, you must first devacuum the cathode-ray tube. Discarded CRTs that have not been devacuumed may crack and implode, injuring anyone nearby.**

Materials Required
Thick cardboard box large enough to contain the CRT
Large, sharp diagonal cutters
Large pliers and duct tape
Safety goggles and gardening gloves
12" x 12" piece of cloth or heavy paper

Devacuuming Procedure

1. Put on safety goggles.
2. In the side of the box, about six inches from the bottom, cut a hole just large enough to insert the tip of the CRT neck.
3. Place the CRT inside the box with the tip of the neck protruding through the hole, and tape the box flaps down with the duct tape (Figure 3).

▲ Warning **Only the very tip of the CRT neck should be protruding through the hole in the box, and the box must not have any other opening.**

4. Put on the gloves and, using the diagonal cutters, carefully clip off the connector pins on the end of the CRT neck (Figure 3).
5. Tape the piece of cloth or paper onto the box so that it forms a veil over the opening, but allows access to the tip of the CRT (Figure 3). The purpose of the veil is to catch bits of glass that may fly during the next step.
6. Make sure no one is standing nearby. Then stand to one side, reach under the veil, and with the large pliers grasp the exposed tip of the CRT. Look away while you snip off the tip of the CRT.

Note You will probably hear a rush of air entering the CRT when the CRT vacuum breaks—but even if you don't, the procedure is complete if the tip of the CRT is clearly broken off.

Figure 3   Devacuuming the CRT

Electrostatic discharge (ESD) can irreparably damage the sensitive CMOS chips and printed circuitry of modern electronic components. Plastic utensils, polystyrene products, polyester clothing, even the ungrounded touch of your hand carry sufficient electrostatic charges to damage electronic components. Follow the ESD prevention rules and set up an ESD-safe workstation as directed below.

ESD Prevention Rules

1. Before working on a device containing a printed circuit, ground yourself and your equipment. Use a grounded conductive workbench mat and a grounding wriststrap, and ground your equipment to the mat.

▲ Warning

Make sure that you are not grounded when:
- **You work on plugged-in equipment**
- **You discharge a cathode-ray tube (CRT)**
- **You work on an unplugged CRT that has not been discharged**
- **You perform live adjustments**

2. Do not touch anybody who is working on integrated circuits. You could "zap" the equipment through the technician—even if the technician is grounded.
3. Use static-shielding bags for boards and chips during storage, transportation, and handling. Leave all Apple service exchange components in their ESD-safe packaging until you need them.
4. Handle all ICs by the body, not the leads. Also, do not touch the edge connectors or exposed circuitry on boards or cards.
5. Do not wear polyester clothing or bring plastic, vinyl, or polystyrene into the work environment. The electrostatic field around these nonconductors cannot be removed.
6. Never place components on any metal surface. Use antistatic, conductive, or foam rubber mats.
7. If possible, keep the humidity in the service area between 70% and 90%, and use an ion generator. Charge levels are reduced (but not eliminated) in high-humidity environments and in areas with ion generators.
8. If an ESD pad/workstation is not available, touch bare metal on the power supply to discharge electrostatic charges.

Setting Up an ESD-Safe Workstation

Materials Required
Conductive workbench mat with ground cord
Wriststrap with built-in 1-megohm resistor and ground cord
Equipment ground cord with alligator clips
Ground/polarity tester

1. Remove all ESD hazards from the area. Nonconductive materials (for example, polyester, plastic, vinyl, and polystyrene) cannot be grounded and retain charges for hours and even days.
2. Use a ground/polarity tester to verify proper grounding of the power outlet. If the outlet is wired incorrectly, most testers show a light pattern that matches a code given on the tester. If the tester does not verify proper grounding, move to another outlet that is safe.
3. Connect the grounding cord of the workbench mat to ground.
4. Use a wriststrap grounding cord. Fasten it to the workbench mat and to the wriststrap. The wriststrap should touch your skin.
5. Finally, ground the equipment you are working on. Use alligator clips and a grounding cord to attach any metal part of the equipment to the grounded workbench mat.

General Information

SIMM Compatibility Chart

DRAM SIMMs for Service Exchange Modules	Macintosh Computers					
	Plus	Classic	Classic II	Performa 200	SE	SE/30
661-0402 256K, PLCC, 120 ns	＊	＊			＊	＊
661-0402 256K, DIP, 120 ns	＊	＊			＊	＊
661-0402 256K, SOJ, 120 ns	＊	＊			＊	＊
661-0402 256K, SOJ, 120 ns	＊	＊			＊	＊
661-0402 256K, SOJ, 120 ns	＊	＊			＊	＊
661-0494 256K, DIP, 120 ns	＊	＊			[1]	[2]
661-0519 256K, SOJ, 80 ns	＊	＊			＊	＊
Slowest acceptable DRAM speed (ns)	150	120	100	100	150	120

[1] Can be installed only in SIMM positions 3 and 4 because of space constraints.

[2] Can be installed only in SIMM Bank A because of space constraints.

General Information

DRAM SIMMs for Service Exchange Modules	Macintosh Computers					
	Plus	Classic	Classic II	Performa 200	SE	SE/30
661-0403 1 MB, SOJ, 120 ns	🍎	🍎			🍎	🍎
661-0410 1 MB, DIP, 120 ns		🍎			[1]	[2]
661-0520 1 MB, SOJ, 80 ns	🍎	🍎	🍎	🍎	🍎	🍎
661-0546 1 MB, SOJ, 80 ns, Parity	[3]	[3]	[3]	[3]	[3]	[3]
661-0719 1 MB, SOJ, 80 ns			🍎	🍎		
661-0643 2 MB, SOJ, 80 ns			🍎	🍎		
Slowest acceptable DRAM speed (ns)	150	120	100	100	150	120

[1] Can be installed only in SIMM positions 3 and 4 because of space constraints.

[2] Can be installed only in SIMM Bank A because of space constraints.

[3] The SIMM is compatible with the CPU, but the CPU does not use the parity feature of this SIMM.

Macintosh ADB Input Devices

This list includes all Apple Desktop Bus™ (ADB) input devices and their part numbers for all Macintosh computers except the Macintosh 128K, 512K, 512Ke, Plus, and Portable.

Apple Keyboard 661-0383
Apple Keyboard II 661-0603
Apple Keyboard, French Canadian C661-0383
Apple Keyboard, Spanish...E661-0383
Apple Keyboard and Apple Keyboard II parts
    Bottom case, AK 815-1017
    Bottom case, AK II, version A 815-6044
    Bottom case, AK II, version B 815-6045
    Cable, ADB keyboard, 1 meter 590-0361
    Cable, ADB keyboard, 1 meter 590-0616
    Key cap set, AK 658-7011
    Keyboard encoder PCB, AK II, version A 981-0020
    Keyboard encoder PCB, AK II, version B 981-0021
    Keyboard cable, 2 meter..590-0152
    Keystem, w/spring, AK II, version B (set of 10) 076-0422
    Keyswitch, locking, tan/ivory, AK, AEK, AEK II........................970-1263
    Keyswitch set, ADB kybd, AK and AEK, tan (set of 10)...........076-0209
    Keyswitch set, ADB kybd, AEK II, ivory (set of 10)..................076-0387
    Rubber dome, AK II, version A (set of 10) 076-0423
    Top case 810-6042
    Top case, AK II, version A 810-6042
    Top case, AK II, version B 810-6043
Apple Extended Keyboard 661-0384
Apple Extended Keyboard, French Canadian...............................C661-0384
Apple Extended Keyboard, German D661-0384
Apple Extended Keyboard, Italian T661-0384
Apple Extended Keyboard, Spanish...E661-0384
Apple Extended Keyboard parts
    Bottom case...815-1019
    Cable, ADB keyboard, 1 meter 590-0361
    Keycap set, AEK and AEK II..658-7010
    Keyswitch, locking, tan/ivory, AK, AEK, AEK II........................970-1263
    Keyswitch set, ADB kybd, AK and AEK, tan (set of 10)...........076-0209
    Keyswitch set, ADB kybd, AEK II, ivory (set of 10)..................076-0387
    Top case 815-1018
Apple Extended Keyboard II 661-0543
Apple Extended Keyboard II, ISO, French EF661-0544
Apple Extended Keyboard II, ISO, French Canadian EC661-0544
Apple Extended Keyboard II, ISO, German.................................ED661-0544

Module Symptom Codes

When returning a defective module to Apple, always enter on the SRO form the symptom code that best describes the problem. Do this as follows:

1. Locate and note the three-digit symptom code from the Module Symptom Codes chart.

2. Select the appropriate modifier code from the list below. This is the fourth digit of the symptom code.

Code	Modifier
1	Continuous
2	Intermittent
3	Environmental/cannot duplicate symptom
4	Always fails after awhile
5	Depends on configuration
6	Fails only with application software
7	Noisy
8	Inoperable upon first use

3. Write the four-digit code on the SRO form.

For example: A Macintosh logic board crashes after being on for an hour or more. The symptom code is 153, "System bombs or crashes." The board fails after it has been in use for awhile, so the modifier code is 4. Place the modifier code after the symptom code, and enter the error code 1534 on the SRO form.

Module Symptom Codes

Code	Startup/Run Problems
150	Bad or no startup tone
151	Screen bright; no Mac face
152	Sad Mac/self-test fail/startup error
153	System bombs or crashes
154	No power light indicator with good power supply
155	Restarts or shuts down randomly
156	Can't shut down
Code	Video/Sound Problems
160	Bad or no color on display
161	Distorted or no video; system boots OK
162	Distorted or no sound; system boots OK

General Information

Code	I/O Device Problems
170	Bad or no response (keyboard, mouse, trackball...)
171	Good game paddle/joystick fails
172	Serial port failures
173	Printing or AppleTalk problem
174	Communications or modem port problems
175	Bad expansion slots (Apple II, Direct, NuBus...)
Code	**Drive I/O Errors**
180	Can't boot/read internal floppy drive
181	Can't boot/read external floppy drive
182	Can't write/format internal floppy drive
183	Can't write/format external floppy drive
184	Can't boot/read internal SCSI drive
185	Can't boot/read external SCSI drive
186	Can't write/format internal SCSI drive
187	Can't write/format external SCSI drive
Code	**Miscellaneous Problems**
190	Control Panel settings don't work
191	Connector or jack problems
192	SIMM socket problems
193	Board is cracked, damaged
194	Bad battery
Code	**CRT and Analog Boards**
250	Black screen
251	Vertical bright line
252	Horizontal bright line
253	Rolls vertically
254	Diagonal stripes
255	Dim or low intensity
256	Fuzzy screen, unclear characters
257	Unstable picture; logic board OK
258	Incorrect picture size or alignment
259	Lighted screen, no picture
260	Fan not spinning
261	Color not adjustable; no color
262	Distorted sound
263	No power, no raster

Code	Drive Problems
350	Won't eject
351	Won't format
352	Drive doesn't spin
353	Too many bad blocks
354	Won't mount
355	Won't recognize disk formatted on other drive
356	Won't read/write data; disk spins
357	Won't write data
358	Excessive read/write errors
359	Won't boot; reads/writes OK
360	Excessive seeking
361	Icon doesn't appear on desktop; formats OK
362	Won't format; able to see drive in SC setup
363	Won't format; unable to see drive in SC setup
364	Unable to access drive; system folder present
365	Noisy; works OK

Code	Power Supply Problems
450	Clicking noise
451	Fuses keep blowing
452	Causes system failure
453	Noisy; works OK
454	No power
455	System randomly resets

Code	Keyboard, Mouse, Input Device Problems
550	No or bad response
551	Bad keyswitch or button
552	Foreign substance spilled on unit
553	Sticky or bouncing keys
554	No cursor response

Code	Printer Problems
650	Improper print head movement
651	Paper won't feed
652	Self-test OK; won't print from host
653	Fails self-test
654	Won't select from front panel
655	Printer not seen in Chooser
656	Prints blank pages
657	Prints black pages
658	Print is distorted or uneven
659	Indicator light suggests fault
660	No power light

General Information

Special Tools Index

Torx Driver
#076-8053

SCSI Loopback Test Card
#077-8219

To mouse
conn. J2

Apple Computer

J1

To mouse
unit J3

Apple Computer

DE-9 Serial Port Plug
(set of 2) #077-8129

CRT Discharge Tool
#076-0381

SIMM Removal Tool
#076-8354

Pull-Apart Tool
#076-8059

IWM/SWIM Extraction Tool
#076-0341

On-Site
Troubleshooting

Overall Approach

```
┌──────────────┐
│ Quick Checks │────────── Perform telephone and on-site quick checks
└──────────────┘
        │
        ▼
┌──────────────┐        ┌── Duplicate problem and gather information
│   Software   │        ├── Go over system-crash checklist
│Troubleshooting│───────┤
└──────────────┘        ├── Perform appropriate desktop procedures
        │               │   and practices
        ▼               └── Check system failure codes for clues
┌──────────────┐
│   Hardware   │────────── Perform hardware troubleshooting
│Troubleshooting│
└──────────────┘
```

Telephone and On-Site Quick Checks

✓ Check the power source and power connection.
✓ Check all cables and cable connections.
✓ Check the adjustment of all user controls.
✓ Check that not more than one system file is on the startup device/disk.
✓ Check that the computer system and the system software are compatible (see System-Software Configurations table in this section).
✓ Open the computer and verify that all circuit boards, fuses, and chips are secure, clean, and undamaged.

Information Gathering

When quick checks do not identify the problem, try duplicating the problem, and gather as much information about the problem as possible. Take special note of the following:

- Operating condition of the system when the problem occurs (application and version, Finder™ or MultiFinder®, system software and version, whether networked, system configuration, peripherals, INITs, CDEVs, DAs, etc.)
- Exactly what your customer is doing when the problem occurs
- What happens to the system (freezes, crashes, displays error message)
- What your customer has tried to do to fix the problem, and the outcome
- If the problem appeared recently, note what your customer recently changed or added to the system

Using this information, perform appropriate solutions from the following System-Crash Checklist. If this systematic approach does not fix the problem, your customer probably has a hardware problem (refer to "Hardware Troubleshooting" later in this section).

System-Crash Checklist

✓ **Check whether the problem is peculiar to one application (try replicating the problem using another application). If the application is at fault, consult the following chart for suggestions.**

Problem	Solutions
Program incompatible with MultiFinder (System 6 only)	1. Try booting offending program first.
	2. Switch to Finder.
	3. Run program from original disks.
Program incompatible with system software	1. Revert to older version of system software.
	2. Remove program from system.
	3. Contact vendor about program update.
Program corrupted	1. System crashes can corrupt program and system software. Remove program.
	2. Reinstall program and system software from original disks.
	3. Reinstall system software.
Insufficient memory to run program	1. If you are using System 7 or MultiFinder with System 6, close other applications and restart program. (You may have to restart system.)
	2. If under MultiFinder, switch to Finder (System 6 only).
	3. Allocate more memory to application. Select application, select **Get Info** from menu bar, and increase allocated memory in dialog box. (MultiFinder or System 7 only)
	4. If applicable, check RAM cache. If cache is set too high, computer diverts some RAM for system use, thus reducing RAM available for programs.
	5. Install additional RAM.
Message "Application is busy or missing" displays	1. Make sure application is present on drive.
	2. Make sure document was created with same version of application as application on drive.
	3. Launch application first; then open document from application.
	4. Rebuild desktop.
	5. Reinstall application.
	6. Run a utility program, such as Norton Utilities, that resets corrupted bundle bits.
Programs (especially DAs, INITs, and CDEVs) conflict	1. Run Compatibility Checker before installing System 7. Remove or update any questionable INITs or CDEVs (System 7 only).
	2. If program was added just prior to problem, remove offending program.
	3. Remove all DAs, INITs, and CDEVs, and replace one at a time until offender is found.

✓ **Check whether the problem is with system software (boot from a floppy) or with multiple system folders (use Find File).**

Problem	Solution
Multiple system folders	– Remove all system folders except folder with Macintosh icon on it (see Desktop Procedures and Practices).
Corrupted system software	– Replace system software. (When replacing corrupted system software, avoid introducing new problems. Always use Installer **on original system software disks**; do not use System 6 Installer with System 7. If you remove System file before running Installer, you must replace fonts and desk accessories. Make copies of your customer's fonts and desk accessories before running Installer. For more information, refer to Replacing the System File under Desktop Procedures and Practices.

Desktop Procedures and Practices

Identifying and remedying problems that may be software related requires familiarity with basic desktop management procedures and practices. An inappropriately managed desktop could cause the following problems.

Multiple System Folder Problems

Symptoms: System crashes; unusual error messages; font and DA lists change unexpectedly.

Occurs: When disks containing system folders are dragged onto system or system software is loaded without using Installer.

Remedy: Locate and remove all system folders without the Macintosh icon on the folder; also remove any extra System or Finder files.

Procedure: Boot from known-good system disk, use Find File to locate and remove multiple system folders, and reboot computer.

INIT and CDEV Conflicts

This problem is very common under System 7. Be sure to run the Compatibility Checker before installing System 7. Remove any questionable INITs or CDEVs (or update them with newer versions and rerun the Compatibility Checker).

Symptoms: System crashes and myriad of other problems.

Occurs: When INIT or CDEV conflicts with an application on system.

Remedy: Locate and remove all INITs and CDEVs, and then replace them one at a time until the conflict returns.

Procedure: Place all INITs and CDEVs in a separate folder within System Folder (this prevents INITs and CDEVs from loading when you boot system), and return each INIT and CDEV to System Folder one at a time. (Renaming an INIT, such as adding a prefix of "Z" so it loads last, may remedy the conflict.)

RAM Cache Out-of-Memory Problems

RAM cache is a feature that speeds up operation of the system. The RAM cache acts as a special RAM buffer between applications and drives. From 32K to 768K of the most frequently used blocks of data can be stored in the RAM cache, which can significantly increase speed within an application and cause applications to launch from and return to the Finder more quickly. Memory problems can occur when the RAM cache is set too high.

Symptoms: Insufficient memory problems; applications won't run; degraded system performance; ID=28 system bombs in systems configured with 1 MB or less of memory.

Occurs: When RAM cache is set too high (available system memory is insufficient to run program).

Remedy: Switch off RAM cache, or reduce amount of memory allocated to RAM cache.

Procedure: Open Control Panel (System 6) or Memory Control Panel (System 7) and reduce RAM cache allocation as desired. Reboot system.

Rebuilding the Desktop / Slow Finder

Symptoms: Finder cannot locate applications that are on disk drive, or Finder is slow.

Occurs: When disk is overloaded with applications and icons, or applications contain excessive number of file comments.

Remedy: Rebuild desktop file (which erases comments from Get Info comment box of all applications on drive).

Procedure: Hold down <Option> and <Command> keys while booting, or while quitting application if operating in Finder. Click **Yes** in resulting dialog box to rebuild the desktop.

Resetting Corrupted Parameter RAM

Symptoms: Macintosh II does not boot from internal hard drive.

Occurs: When an application crashes, it sometimes executes code that corrupts parameter RAM (PRAM) on Macintosh II systems running system software prior to release 5.0. PRAM contains information required by the Macintosh operating system (OS) to start up from an internal SCSI drive, as well as other OS information.

Remedy: Reset PRAM to its default value.

Procedure: System 6: Hold down <Shift>, <Option>, and <Command> keys while opening Control Panel. Click **Yes** in resulting dialog box to clear PRAM, which resets some user options to their default values.
System 7: Hold down <Option>, <Command>, <P>, and <R> during startup but before "Welcome to Macintosh" appears. (If using a Macintosh II family computer with a color monitor, the monitor will default to monochrome; reset the color controls.)

Restoring Damaged Boot Blocks

Symptoms: System does not recognize or boot from hard drive.

Occurs: When startup instructions (boot blocks) on the hard drive are damaged or the hard disk driver is damaged.

Remedy: Replace the hard disk driver.

Procedure: Boot the computer from a startup disk that contains an appropriate hard disk setup program. (For Apple hard drives, use the *Apple HDSC Setup* program found on a *Macintosh System Utilities* disk.) Install or update the hard disk driver on the hard drive.

Removing and Preventing Viruses

Symptoms: Unexplained system crashes; corrupted or disappearing files.

Occurs: After using a disk or program that is infected by a virus (often contracted from shareware found on electronic bulletin boards).

Remedy: Use an antivirus program to eradicate the virus, and practice virus prevention in the future.

Procedure: Boot the computer from a startup disk that contains an antivirus application and launch the eradication program. There are several effective antivirus programs, including *Disinfectant* by John Norstad, *Interferon* and *Virex* by Robert Woodhead, and *SAM* from Symantec.

Prevention: Many of the antivirus applications include programs for screening inserted disks for known viruses—use them! Also, master disks should be locked; applications can be protected by locking them using the Get Info box. If running System 7, be sure the virus utility is System 7 compatible. Incompatible versions can cause unexpected problems that are difficult to track down.

Replacing the System File (System 6 only)

Symptoms: Minor, intermittent problems accessing disks, printing, starting system, or launching programs.

Occurs: When System file or related files are damaged, often from disk writing errors.

Remedy: Replace the System file using the Installer. To ensure that the problem is corrected, you should remove the entire System Folder before using the Installer.

Procedure: Copy all non-Apple System Folder files from the System Folder to another folder on the desktop (see list of Apple System Folder files below). Then drag the System Folder into the Trash and start up the Installer program from the original system software disk. Place the non-Apple files in the new System Folder. (For information about using the Installer, refer to "Replacing/Installing System Software" later in this section.)

Apple Files: (System 6)			
Access Privileges	Key Layout	MultiFinder	Finder
Backgrounder	AppleShare	Keyboard	Mouse
Clipboard File	DA Handler	Responder	Color
Startup Device	Easy Access	Monitors	System
Scrapbook File	Finder Startup	General	Sound

System Failures

You are experiencing a serious system failure if your screen fills with dots, strange patterns, or garbage characters, or your computer emits sounds similar to muted gunfire. Other system failures, often called crashes, can result in a hung system (for instance, your cursor is frozen in place on the screen) or a system bomb with an error message and ID number. Often your only alternative is to press the reset button on the programmer's switch or restart the computer. However, if you encounter an alert box containing an error message and code, check the error code against one of the tables on the following pages.

You can encounter three types of Macintosh system error codes: boot (Sad Mac®) error codes, system error codes, and negative value error codes. Explanations of these error codes can be found in the following tables. When possible, these explanations include suggestions that may help isolate the problem. Additional suggestions are given below on this page. If these suggestions and the software troubleshooting recommendations on the previous pages of this section do not help, you probably have a hardware problem. Refer to "Startup Problems—Flowcharts" later in this section.

Introduction

Sad Mac, system, and application error codes can help lead you to the source of the problem. If the error code tables do not recommend a solution, or the solution does not fix the problem, keep in mind that serious system failures can be caused by:

- Software problems (damaged program or system files, incompatible INIT files)
- Data problems (damaged or incomplete data files, corrupted PRAM)
- Damaged boot blocks
- Hardware problems

To rectify system problems, try rebuilding the desktop and restarting your system. If this procedure does not rectify the problem, use another startup disk and try:

1. Removing INITs from your system (especially INITs added recently)
2. Checking the disk for a virus
3. Replacing the System file and Finder using Installer
4. Replacing the application with a fresh copy from the master disk
5. Resetting PRAM
6. Restoring the boot blocks

For instructions on performing these procedures, refer to Desktop Procedures and Practices earlier in this section.

Sad Mac Error Codes

If a Macintosh Plus fails at startup, you will see a Sad Mac icon and a six-digit error code. If a Macintosh SE fails at startup, the problem is usually bad RAM and you will see a 16-digit SIMM error code (see the Macintosh SE chapter). If other Macintosh computers fail at startup, you will hear a series of error chords (see Flowchart 2, Startup and Error Chords).

Sad Mac error codes can mean that the computer has failed the internal diagnostic tests and you have a hardware problem. Sad Mac codes can also have less serious causes such as:

- A non-system disk in the default drive
- A bad boot disk
- An incompatible system file on the boot disk
- No Finder on the boot disk
- A stuck programmer's switch

Sad Mac Icon

Sad Mac Error Codes

Code	Meaning	Code	Meaning
01_ _ _ _	ROM test failure	0F0006	Overflow trap - TRAPV instruction[2]
02_ _ _ _	RAM test failure (bus subtest)[1]	0F0007	Privilege violation[2]
03_ _ _ _	RAM test failure (byte write)[1]	0F0008	Trace trap[2]
04_ _ _ _	RAM test failure (mod3 test)[1]	0F0009	Trap dispatcher error[2]
05_ _ _ _	RAM failure (address uniqueness)[1]	0F000A	Line 1111 trap[2]
0F0001	Bus error[2]	0F000B	Other trap[2]
0F0002	Address error[2]	0F000C	Unimplemented trap executed[2]
0F0003	Illegal instruction[2]	0F000D	Interrupt button, programmer's switch[2,3]
0F0004	Zero divide[2]	0F0064	Bad System file[2,4]
0F0005	Check trap - CHK instruction[2]	0F0065	Bad Finder[2]

1 The first two digits indicate a RAM failure; the last four digits identify (in hexadecimal) the suspected bad chip. Try removing the SIMMs, rubbing the connection area with an eraser to improve the connection, and replacing the SIMMs. If this procedure doesn't help, isolate the bad SIMM (refer to Flowchart 3, SIMM Verification).
2 "0F" indicates a software error—the startup device was spinning before the failure occurred. Try: (1) Restarting the computer with the <Option> and <Command> keys held down (rebuilding the desktop) or (2) Replacing the System file.
3 Check the interrupt button—it could be stuck.
4 The System file may be missing from the startup drive.

System Error Codes

The two-digit system error code is located in the lower-right corner of the dialog box that informs you "A serious system error has occurred." Refer to the following two tables for a list of these codes and an explanation of their meaning.

System Error Codes

Code	Type	Meaning
01	Bus error	Program attempts to access an invalid memory location. Error is often caused by corrupt application. Replace application with known-good copy or upgraded version. If replacing software does not help, the problem is probably hardware related.
02	Address error	A corrupt application has placed program information in an odd vs. even address location. Install a known-good copy or upgraded version of the application.
03	Illegal instruction	Processor receives an instruction that does not match its internal list of instructions.
04	Zero divide	Programmer told processor to divide by 0 (mathematically impossible).
05	Range check error	Index is out of range (for example, programmer declares an array of five elements and searches for the sixth).
06	Overflow	Computer attempts to store a number that is too large for the allotted space.
07	Privilege violation	68000 is running in "user" mode and attempts to execute a command that requires "supervisor" mode.
08	Trace mode error	68000 chip can trace itself for debugging; can interfere with normal execution.
09	Line 1010 trap	Processor cannot execute a ROM call accessed via a trap with a hexadecimal "A" code. Often caused by a corrupt application. Replace application with a known-good copy or upgraded version.
10	Line 1111 trap	An incorrect ROM call.
11	Exception error	A miscellaneous hardware error not covered elsewhere.
12	Unimplemented core routine	Occurs when program attempts to execute a ROM call via an undefined trap.
13	Uninstalled interrupt	Needed routines are not available or the interrupt switch is pressed when a runtime debugger is not present.
14	I/O core error	Error in the file system or the device manager system.
15	Segment loader error	System could not load needed segment from disk into RAM memory. Often caused by a corrupt application. Replace application with a known-good copy or upgraded version.
16	Floating point error	A mathematical error.

Code	Type	Meaning
17-24	Packages not present (0-7)	System tries/fails to read special sections of the System file called "packages." System file may be damaged.
25	Memory full	Program requests a chunk of memory, but the system couldn't find enough.
26	Bad program launch	Attempt to load program without a CODE resource of 0; program is not a real program. Often caused by a corrupt application. Replace application with a known-good copy or upgraded version.
27	File system map damaged	Something is wrong with information on the disk. Try rebuilding the desktop.
28	Stack ran into heap	Two competing areas, the stack and heap, have collided. You're out of memory or memory is not being managed properly.
30	Disk insertion error	
31	No disk insertion	
33	negZcbFreeErr	ZcbFree has gone negative.
41	Finder error	Attempt to boot with startup disk that does not contain Finder. Create a new startup disk.
51	Bad slot interrupt	Unserviceable slot interrupt.
81	Bad SANE opcode	Bad opcode given to SANE Pack 4.
84	Menu purge error	Happens when a menu is purged.
85	MBarNFnd	System error—cannot find MBDF.
86	HMenu Find error	System error—recursively defined HMenus.
87	WDEFnFND	Could not load WDEF.
88	CDEFnFND	Could not load CDEF.
89	MDEFnFND	Could not load MDEF.
98	No patch	Can't patch for particular model Macintosh.
99	Bad patch	Can't load patch resource.
101	Parity error	Memory parity error.
102	Old System	System is too old for this ROM.
103	32-bit mode	Booting in 32-bit mode on a 24-bit system.
20000	Shut down or restart	User can choose ShutDown or Restart.
20001	Switch off or restart	User can choose to switch off or Restart.
20002	Forced quit	Allows user to exit to Shell.
32767	System error	General system error.

Negative Value Error Codes

Rather than receive an error message such as "The disk is locked," you may receive a negative value error code such as -44. Refer to the Negative Value Error Codes table below for these codes and their general meanings. If you need more specific information, refer to the Technical Info library on AppleLink®.

Negative Value Error Codes

Code	Error Type
0 to -8	General system errors
-9 to -21	Color manager errors
-17 to -30	I/O system errors
-33 to -61	File system errors
-64 to -66	Font manager errors
-64 to -90	Disk, serial ports, clock specific errors
-91 to -99	AppleTalk errors
-100 to -102	Scrap manager errors
-108 to -117	Storage allocator errors
-120 to -127	HFS errors
-126 to -128	Menu manager errors
-130 to -132	HFS file ID errors
-147 to -158	Color QuickDraw and color manager errors
-185 to -199	Resource manager errors (other than I/O)
-200 to -232	Sound manager errors
-250 to -261	MIDI manager errors
-299	Notification manager error
-290 to -351	Start manager errors
-360 & -400	Device manager slot support errors
-450 to -463	Edition manager errors
-470 to 489	SCSI manager errors

Code	Error Type
-500	QuickDraw error
-501	Text edit error
-502	O/S error
-600 to -610	Process errors
-620 to -625	Memory dispatch errors
-800 to -813	Database access (Pack 13) errors
-850 to -863	Help manager errors
-900 to -932	AppleTalk — PPC toolbox errors
-1024 to 1029	AppleTalk — NBP errors
-1066 to -1075	ASP errors (XPP driver)
-1096 to -1105	AppleTalk — ATP errors
-1273 to -1280	Data stream protocol — DSP driver errors
-1300 to -1305	HFS errors
-1700 to -1719	AppleEvent errors
-3101 to -3109	AppleTalk — ATP errors
-4096 to -4101	Print Manager w/LaserWriter
-5000 to -5021	File manager extensions errors
-5000 to -5032	AFP errors (XPP driver)
-5500 to -5502	SysEnvirons errors
-5550 to -5553	Gestalt errors
-8132 to -8160	LaserWriter driver errors
-11000 to -10005	PictInfo errors
-13000 to -13005	Power manager errors
-23000 to -23048	Mac TCP errors
-32640 & -32768	Primary or secondary INIT code errors

Isolating a Hardware Problem

```
  ┌─────────────────┐        ┌── Diagnostic error chords
  │ System Self-Tests├────────┤
  └────────┬────────┘        └── System error codes
           │
           ▼
  ┌─────────────────┐        ┌── MacTest
  │Diagnostic Software├───────┤
  └────────┬────────┘        └── Macintosh Hard Drive Test
           │
           ▼
  ┌─────────────────┐        ┌── Symptom/cure charts
  │  Symptom/Cure   ├─────────┤
  │     Charts      │        └── Module swapping
  └────────┬────────┘
           │
           ▼
  ┌─────────────────┐
  │ Troubleshooting ├────────── Startup problem flowcharts
  │   Flowcharts    │
  └─────────────────┘
```

- System Self-Tests—Start up the customer's system, listen for diagnostic error chords (see Flowchart 2, Startup and Error Chords in this section), and look for system error codes (refer to "System Failure Codes" in this section).

- Diagnostic Software—If the system passes the self-tests but the problem persists, try running the appropriate *MacTest*™ program (refer to *MacTest* later in this section for *MacTest* versions and procedures). If you suspect a hard drive problem, you should also run the *Macintosh Hard Drive Test* program.

- Symptom Charts/Module Swapping—If the customer's system (or *MacTest*) does not boot or *MacTest* fails to find the problem, refer to the symptom/cure charts in the section that covers your customer's computer. If you think you recognize the problem and you have the necessary replacement module with you, try module swapping.

- Troubleshooting Flowcharts—If the customer's system (or *MacTest*) does not boot or *MacTest* fails to find the problem and the problem is not clearly defined or not listed in the symptom/cure charts, refer to "Startup Problems—Flowcharts" at the end of this section. These flowcharts present a step-by-step procedure for isolating the problem.

Hardware Troubleshooting Guidelines

1. Use only known-good test equipment and diagnostic programs.
2. The troubleshooting tools are designed to test a system in its minimum configuration. Disconnect external peripherals and remove all NuBus™ cards. After verifying that the computer is fully operational, reinstall or reconnect and test each expansion card and external device one at a time.
3. When using the symptom/cure charts, always try the solutions one at a time, in sequence, until you fix the problem. If the problem remains, reinstall the original module before trying the next solution.
4. The hardware troubleshooting flowcharts verify each repair action by looping back to the start (Flowchart 1). If a repair does not fix the problem, reinstall the original module, return to the flowblock of origin, and perform the next repair action on the list.
5. When instructed to replace the logic board only, place the customer's SIMMs on the replacement logic board. Be sure to use the SIMM removal tool (see "Special Tools Index" under General Information). To test the customer's SIMMs, refer to Flowchart 3, SIMM Verification, in this section.
6. Always verify that the original problem has been fixed. To verify that the original problem is fixed, duplicate the conditions under which it appeared. To verify that there are no additional faults, run *MacTest*.

Startup Problems—Flowcharts

START

Turn on system without startup disk.

NOTE: At startup you should hear medium-pitched soft chord.

Is startup sequence normal? — No → Go to Flowchart 2.

Yes

Does disk icon with smiling face or flashing "?" appear? — No → Go to Flowchart 4.

Yes

Boot appropriate *MacTest* disk.

Does test screen appear? — Yes →

No

Shut down and install known-good *MacTest* disk. Switch on power.

Does test screen appear? — No → Go to Flowchart 6.

Yes

Run *MacTest*. Run *Macintosh Hard Drive Test*. Verify no faults.

END

Flowchart 1   Startup Problems

START

If an error is encountered at startup you will hear:
1. A medium-pitched, soft startup chord (normal).
2. An error chord (not normal).
3. A test monitor chord (four chords, low to high).

Pay close attention to the error (second) chord.

Is error chord a short, harsh chord? — **Yes** →

Initial hardware self-tests failed.
1. Replace the logic board only. Install customer's SIMMs on the replacement logic board.
2. Install exchange SIMMs on customer's logic board.
3. Verify customer's SIMMs.

No

Is error chord a meduim-pitched chord? — **Yes** →

No

Is error chord a meduim-pitched, then high chord? — **Yes** →

RAM self-test failed.
1. If system is Macintosh IIfx, check for NEC SIMMs. Replace NEC SIMMS with date code below 9052.
2. Install exchange SIMMs in Bank A of customer's logic board
3. Install exchange SIMMs in Bank B of customer's logic board.
4. Replace the logic board.
5. Verify customer's SIMMs.

No

Return to Flowchart 1.

Go to Flowchart 3.

Flowchart 2   Startup and Error Chords

On-Site Troubleshooting

NOTE: When verifying SIMMS, you need:
1. As many known-good SIMMS as SIMM slots in each bank of the customer's logic board.
2. Known-good SIMMs the same size as the customer's SIMMs.

START

Install known-good SIMMs in Bank A. Leave one SIMM slot empty.

Install one of the customer's SIMMs in the empty slot in Bank A.

Place the drive mount into position, connect one drive cable only, and switch on system power.

1. Switch off system power.
2. Remove, mark, and set aside the customer's bad SIMM.
3. Check next customer's SIMM.

No ← Do you hear normal startup chord and see disk with flashing "?" ?

Yes

1. Switch off system power.
2. Remove another known-good SIMM.
3. Install another of the customer's SIMMs.

No ← Is this the last customer SIMM to be installed in Bank A?

Yes

Repeat for Bank B.

No ← Is this the last customer SIMM to be installed in Bank B? → Yes → Return to Flowchart 1.

Flowchart 3   SIMM Verification

```
                    ┌─────────┐
                    │  START  │
                    └─────────┘
                         │
                         ▼
        ┌────────────────────────────────────┐
        │ 1. Disconnect hard drive power     │
        │    and data cable connectors.      │
        │ 2. Disconnect disk drive 2 cable.  │
        │ 3. Run system from drive 1 only.   │
        └────────────────────────────────────┘
                         │
                         ▼
        ┌────────────────────────────────────┐
        │ Switch on system without startup disk. │
        └────────────────────────────────────┘
                         │
                         ▼
```

NOTE: Suspected problem areas include system video, system logic and control, and system power.

NOTE: You must install a filter block and terminator to boot a Macintosh IIfx with the hard drive power and data cable connectors disconnected.

```
        ◇ Is                    No      ◇ Is
          any video      ──────────▶      LED lit        No      ( Go to
          displayed?                      and fan      ──────▶    Flowchart 5. )
                                          running?
             │ Yes                           │ Yes
             ▼                                │
        ◇ Does          Yes    ( Go to       │
          disk icon with ────▶   Flowchart 6 │
          flashing "?"          section A. ) │
          appear?                            │
             │ No                            │
             ▼                               │
        ◇ Is                          ┌──────┴──────────────────────────┐
          video          Yes          │ 1. Replace video cable.          │
          displaying   ──────────────▶│ 2. Replace monitor. If now OK,   │
          unrecognizable              │    troubleshoot monitor. If not  │
          garbage?                    │    OK, go to box below.          │
             │ No                     └──────────────────────────────────┘
             ▼                               │
        ◇ Is an         No           ┌───────┴──────────────────────────┐
          error icon  ──────────────▶│ 1. Replace video interface card. │
          displayed?                 │    If now OK, troubleshoot replace-│
             │ Yes                   │    able RAM on bad card.          │
             └─────────────────────▶ │ 2. Replace logic board SIMMs. Go  │
                                     │    to Flowchart 3 SIMM Verification.│
                                     │ 3. Replace logic board. Be sure   │
                                     │    to install customer's SIMMs on │
                                     │    replacement logic board.       │
                                     │ 4. Replace power supply.          │
                                     └───────────────────────────────────┘
                                             │
                                             ▼
                                        ( Go to
                                          Flowchart 6. )
```

Flowchart 4   Startup Problems

START

NOTE: Suspected problem areas include system video, system logic and control, and system power.

Turn off system power, remove the top cover, and check the lithium batteries with a volt-meter. The batteries must read:
- 2.8 V or higher - Macintosh SE, SE/30, IIcx, IIci, IIvx, IIvi, and Performa 600.
- 3.0 V or higher - Macintosh Classic, Classic II, LC, LC II, IIsi, Performa 200, and Performa 400.
- 3.2 V or higher - Macintosh II, IIx, IIfx, Quadra 700, and Quadra 900/950.

Are batteries OK?

Yes → 1. Replace power supply.
2. Replace logic board. Be sure to install customer's SIMMs on replacement logic board.

Go to Flowchart 7.

No

Replace bad batteries and continue procedure.

Is LED lit and fan running?

No

Yes

Does disk icon with smiling face or flashing "?" appear?

No → 1. Replace video cable.
2. Replace monitor. If now OK, troubleshoot monitor.
3. Replace video interface card. If now OK, troubleshoot replace-able RAM on bad card.
4. Replace logic board SIMMs. Go to Flowchart 3 SIMM Verification.
5. Replace logic board. Be sure to install customer's SIMMs on replacement logic board.
6. Replace power supply.

Yes

Go to Flowchart 7.

Return to Flowchart 1.

Flowchart 5   Startup Problems

START

If necessary, switch off system and disconnect:
1. Hard drive power and data cable connectors.
2. Second disk drive cable.

NOTE: Suspected problem areas include the input/output devices, hard drive, system logic and control, and system power.

Boot *MacTest* disk.

Does test screen appear?

No →
1. Replace drive 1 cable.
2. Replace disk drive 1.
3. Replace power supply.
4. Replace logic board. Be sure to install customer's SIMMs on replacement logic board.

Yes ↓

A → Run *MacTest*.

Return to Flowchart 1.

Switch off system power and reconnect second drive if present. Switch on system power.

Does disk icon with smiling face or flashing "?" appear?

No →
1. Replace drive 2 cable.
2. Replace disk drive 2.
3. Replace power supply.
4. Replace logic board. Be sure to install customer's SIMMs on replacement logic board.

Yes ↓

Return to Flowchart 1.

Boot *MacTest* disk.

Does test screen appear?

No

Yes ↓

Go to Flowchart 7.

Flowchart 6   Startup Problems

```
                    ┌─────────────┐
                    │    START    │        NOTE: Suspected problem
                    └──────┬──────┘        areas include the hard drive,
                           │               system logic and control,
                           ▼               and system power.
                  ┌─────────────────┐
                  │  Run MacTest.   │
                  └────────┬────────┘
                           │
                           ▼
            ┌──────────────────────────┐
            │ Switch off system power and │
            │ reconnect second drive if pre-│
            │ sent. Switch on system power.│
            └──────────────┬───────────┘
                           │
                           ▼
                    ╱╲                      ┌──────────────────────────────┐
                   ╱  ╲                     │ 1. Replace hard drive power and│
                  ╱Does╲                    │    data cables.               │
                 ╱disk icon╲   No           │ 2. Replace hard drive.        │
                ╱with smiling╲──────────────│ 3. Replace power supply.      │
                ╲face or flashing╱          │ 4. Replace logic board. Be sure│
                 ╲ "?" appear? ╱            │    to install customer's SIMMs on│
                  ╲          ╱              │    replacement logic board.   │
                   ╲        ╱               └───────────────┬──────────────┘
                    ╲ Yes  ╱                                │
                     ▼                                      ▼
            ┌─────────────────┐                   ┌──────────────┐
            │ Boot MacTest disk.│                 │  Return to   │
            └────────┬────────┘                   │  Flowchart 1.│
                     │                            └──────────────┘
                     ▼
                  ╱╲
                 ╱  ╲   No
                ╱Does ╲──────────────┐
               ╱test screen╲          │
               ╲ appear?   ╱          │
                ╲        ╱            │
                 ╲ Yes  ╱             │
                  ▼                   │
          ┌─────────────────┐         │
          │ Run MacTest. Run │        │
          │ Macintosh Hard Drive│     │
          │ Test. Verify absence│     │
          │    of faults.    │       │
          └────────┬────────┘        │
                   │                 │
                   ▼                 │
            ┌─────────────┐          │
            │     END     │          │
            └─────────────┘          │
```

Flowchart 7   Startup Problems

Replacing/Installing System Software

You may need to install system software at the customer's site. Replacing hard drives on systems that shipped with the operating system already installed requires reinstalling system software.

Installing System Software Versions 6.0.2 to 6.0.4

You'll need System Software, version 6.0.2, 6.0.3, or 6.0.4 (System & Printing Tools, Utilities 1 & 2).

1. Insert the *System Tools* disk in a floppy drive, and switch on the computer.
2. Double-click on the *System Tools* disk icon, the Setup Folder, and Installer.
3. Select the drive on which you want to install system software. Click **Drive** until you see the desired drive.
4. Select your computer type and click **Install.**
5. When finished, quit the Installer and reboot.

Installing System Software Versions 6.0.5 to 6.0.8

The Installer has Easy Install and Customize options. Easy Install automatically installs system and printer software that is appropriate for the destination drive and your computer. You must use the Customize option to install AppleShare® workstation software. You can also use the Customize option to create a boot disk with the minimal software required for any Macintosh system.

You'll need System Software, version 6.0.5, 6.0.6, 6.0.7, or 6.0.8 (System & Printing Tools, Utilities 1 & 2, and HyperCard®).

1. Insert the *System Tools* disk in a floppy drive and switch on the computer.
2. Double-click on the *System Tools* disk icon and on the Installer.
3. When the welcome screen appears, click **OK**.
4. Select the drive on which you want to install system software. Click **Switch Disk** until you see this drive.
5. Easy Install: Click **Install.** The appropriate software is automatically installed.
    Customize: Click **Customize**. Then select (click or shift-click) the software you wish to install from the options listed in the scrollable window. Click **Install**. The selected software is then installed.
6. When finished, quit the Installer and reboot.

Installing System Software Version 7 or Later

Note   It's a good idea to make a backup copy of your hard drive before you install System 7.

1. Insert *Before You Install System 7* into a floppy drive.
2. Click on the Compatibility Checker option. If you see a button labeled Set Up, click the Set Up button, then choose which disks you want to check.
3. Click **Start Checking**. The Compatibility Checker scans your system and displays messages that report the progress of the scan.
4. If the Compatibility Checker finds incompatible or unknown items in the System Folder of your startup disk, you'll see the message "Attention: Potential problems with System Folder items." To move these items out of your System Folder, click **Move Items**.
5. When the Compatibility Checker finishes examining your system, you'll see the results displayed on the screen. The table below lists what you should do about each type of item on the report.

Item	What to Do
Incompatible or unknown items in the System Folder	Remove these items from the System Folder before installing System 7. (If you used the Move Items button, these items have already been moved to the May Not Work With System 7 folder.)
Other incompatible or unknown programs	You can install System 7—however, you should upgrade to a compatible version of these programs before using them with System 7.
Mostly compatible programs	No action is necessary. (If you like, you can obtain a more recent version.)
Compatible programs	No action is necessary.

6. Insert the *Install 1* disk into a floppy drive, and switch on the computer. The Installer welcome screen appears.
7. Click **OK** to clear the welcome screen. The dialog box that appears provides two options—Easy Install and Customize. Easy Install is suitable for most Macintosh users.
8. Select the drive on which you want to install system software. Click **Drive** until you see the desired drive.
9. Click **Install.**
10. Follow the on-screen instructions, and insert other floppy disks as requested.
11. When you see a message reporting that the installation was successful, click **Quit.**

System-Software Configurations

Macintosh Computer	Recommended System and Finder Versions	Acceptable System and Finder Versions
128K	System 2.0/Finder 4.1	
512K	System 3.2/Finder 5.3	
512Ke	System 3.2/Finder 5.3 System 3.3/Finder 5.4 System 3.4/Finder 5.4	System 4.0/Finder 5.4 System 4.1/Finder 5.5
Plus	System 6.0.2/Finder 6.1 System 6.0.3/Finder 6.1 System 6.0.4/Finder 6.1 System 6.0.5/Finder 6.1 System 6.0.7/Finder 6.1 System 6.0.8/Finder 6.1	System 3.2/Finder 5.3 System 3.3/Finder 5.4 System 4.0/Finder 5.4 System 4.1/Finder 5.5 System 4.2/Finder 6.0 System 7*
SE	System 6.0.2/Finder 6.1 System 6.0.3/Finder 6.1 System 6.0.4/Finder 6.1 System 6.0.5/Finder 6.1 System 6.0.7/Finder 6.1 System 6.0.8/Finder 6.1	System 4.0/Finder 5.4 System 4.1/Finder 5.5 System 4.2/Finder 6.0 System 7*
SE/30	System 6.0.3/Finder 6.1 System 6.0.4/Finder 6.1 System 6.0.5/Finder 6.1 System 6.0.7/Finder 6.1 System 6.0.8/Finder 6.1	System 7*
Classic	System 6.0.7/Finder 6.1 System 6.0.8/Finder 6.1	System 7*
Portable	System 6.0.5/Finder 6.1 System 6.0.7/Finder 6.1 System 6.0.8/Finder 6.1	System 6.0.4/Finder 6.1 System 7*
Performa 200	System/Finder 7.0.1P	System/Finder 7.0.1
Classic II, PowerBook 100, 140, 145, 170, 160, 180	System/Finder 7.0.1	
PowerBook Duo 210, 230	System/Finder 7.1	
* These computers will run System 7 if they have sufficient memory.		

MacTest

When used as stand-alone tests, the *MacTest* diagnostic programs perform pass/fail functional tests of the Macintosh computer systems. The procedures for using all *MacTest* programs are similar, but not identical. Be sure to use the *MacTest* program for the system you want to test. The following table lists the *MacTest* program you need to test Apple products.

MacTest Diagnostics

Diagnostic	Products Tested
MacTest Pro	Macintosh SE/30 Macintosh Classic II Macintosh PowerBook 100, 140, 145, 160, 170, 180 Macintosh PowerBook Duo 210, 230 Macintosh Performa 200, 400, 600 Macintosh LC, LC II Macintosh II, IIx, IIfx Macintosh IIcx Macintosh IIvx, IIvi Macintosh Quadra 700, 900, 950 Macintosh NuBus video cards Macintosh monitors and displays Macintosh drives and storage devices Macintosh modems Apple IIe Card
MacTest CL	Macintosh Classic
MacTest Portable	Macintosh Portable
MacTest MP	Macintosh IIsi Macintosh IIci Cache Card
MacTest IIcx/IIci	Macintosh IIci PC 5.25 Drive Card
MacTest v. 7.0	Macintosh 128K, 512K, Plus
MacTest SE v3.0	Macintosh SE

Be sure to read the Read Me file that accompanies the *MacTest Pro* diagnostic. This file has the latest information about and operating tips for running the diagnostic.

Things to Remember

- Use *Apple DiskCopy* 4.2 to make a backup copy of the *MacTest* disks. Do not write-protect your working disk.
- Some *MacTest Pro* bootable disks contain special System Enabler files for use on Macintosh IIvi, IIvx, Performa, and Macintosh PowerBook 160/180 systems. Do not remove these files from the bootable disks.

- If you cannot boot the *MacTest* disk:
  a. Check the power cable and internal cable connections.
  b. Refer to the appropriate symptom/cure chart, and replace the module(s) specified for your problem.
- (**Macintosh Portable only**) The power adapter must be connected to the Macintosh Portable for the *AppleCat®/MacTest* diagnostic to operate.
- The application memory partition of *MacTest Pro* is set to 800K, but 1024K is the preferred setting. If the computer under test has more than 2 MB of RAM, Apple suggests you set the application memory partition to 1024K. (Click once on the the *MacTest Pro* application icon to highlight it. Select **Get Info** from the File pull-down menu and set the memory size to 1024K.)
- Do not press the reset or interrupt switch while the RAM test is running. Pushing reset causes the RAM test to fail, and pressing interrupt could damage the *MacTest* disk.
- After completing the repair, always run *MacTest* to verify that there are no other faults.

Running MacTest

1. (**Macintosh Portable only**) Plug in the power adapter and connect it to the Portable.
2. Connect the following loopback equipment:
   - For *MacTest Pro*: No loopbacks needed unless you're running the COMM Test TMOD. Use a serial loopback cable (mini DIN-8 cable) between serial ports when running the COMM Test TMOD.
   - Macintosh 128K/512K: DE-9 serial port plugs (2) to serial ports.
   - Macintosh Classic and IIci: SCSI loopback test card to SCSI port and serial loopback cable (mini DIN-8 cable) between serial ports.
3. (**Macintosh Portable only**) Reset the power manager by simultaneously depressing and then releasing the reset and interrupt switches.
4. Boot the *MacTest* disk.
5. Select tests from the Test Selections menu.
6. To loop on selected tests, select **Loop On Selected Tests** from the Test Selections window.
7. Click **Start.**

If you have any problems launching or running *MacTest Pro*, try the following:

- Turn off screen savers before running tests.
- Remove, disable, or turn off INITs, control panel devices (CDEVs), and desk accessories (DAs).
- If you're using System 7, turn off virtual memory and file sharing, or use the Memory Control Panel to put the machine into 32-bit addressing mode. Then restart the computer.
- Use the Chooser to set AppleTalk to Inactive, and then restart the computer.
- When using *Apple Video Cards Tests, Display Test Patterns*, or *Macintosh Quadra 700/900/950 Tests*, initialize the attached monitors by using the Monitors Control Panel.
- Do not launch or run other applications before, after, or while you are running diagnostic tests without restarting the machine.
- After running destructive tests, save the test log if desired, and then restart the computer. Do not print the test log or run any other application before you restart the computer.
- Run tests twice if there is any doubt about test results or any question about the operation of the computer
- Remove any test module files that aren't required.

If you need additional information, refer to the documentation that accompanies the *MacTest* program.

SCSI Loopback Jumper

The SCSI loopback card must be jumpered between J1 pin 25 and RP1 pin 14 in order to be used with *MacTest*. New loopback cards have the jumper etched into the card circuitry. Older versions of the card need the jumper installed.
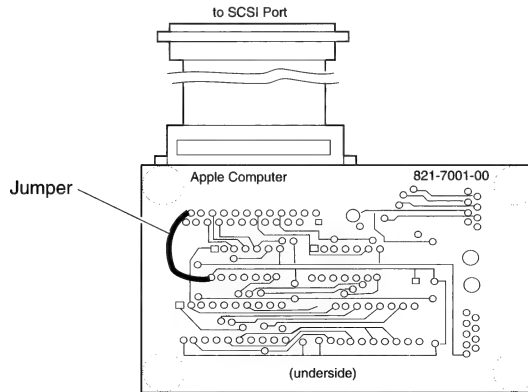

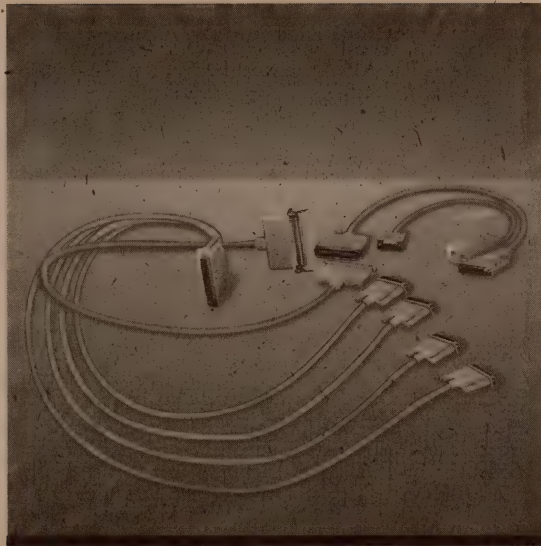**Figure 1   Older SCSI Loopback Card with Jumper**

Determining If a Jumper Is Needed

1. Look at the part number on the back of the SCSI loopback card.
2. If the part number ends with the letter A, the jumper is included in the card circuitry.
3. If the part number ends with double zeros (00), check to see if the card has an external jumper installed from J1 pin 25 to RP1 pin 14. If there is no external jumper, install one.

Installing the Jumper

1. Locate J1 pin 25 and RP1 pin 14 on the SCSI loopback card (see Figure 1). J1 pin 25 is the pin closest to the upper-left corner of the card; RP1 pin 14 is in the middle line of pins and closest to the left edge of the card.
2. Solder a wire connection between J1 pin 25 and RP1 pin 14 on the SCSI loopback card.
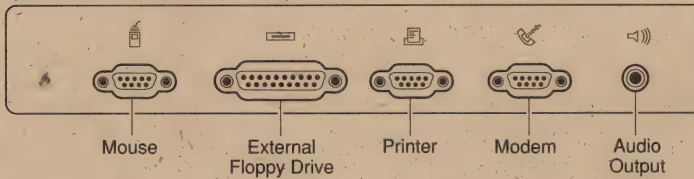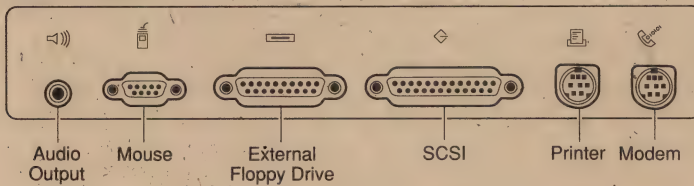
Ports, Cables, and Pin-Outs

Computer Port Locations

Macintosh 128K, 512K, 512K enhanced

Mouse · External Floppy Drive · Printer · Modem · Audio Output

Macintosh Plus

Audio Output · Mouse · External Floppy Drive · SCSI · Printer · Modem

Macintosh SE & SE/30

Apple Desktop Bus · External Floppy Drive · SCSI · Printer · Modem · Audio Output

Macintosh Classic

Apple Desktop Bus · External Floppy Drive · SCSI · Printer · Modem · Audio Output

Macintosh Classic II / Performa 200

Microphone Input · Apple Desktop Bus · External Floppy Drive · SCSI · Printer · Modem · Audio Output

Macintosh Portable

Video   External   SCSI   Internal   Apple   Modem   Power
         Floppy   Modem   Desktop   Adapter
         Drive   (option)   Bus   Printer   Audio
                                                            Output

PowerBook 100

Power   Internal   Apple   Printer   External   SCSI   Audio
Adapter   Modem   Desktop   Floppy   Output
          (option)   Bus   Drive

PowerBook 140/145/170

Power   Internal   SCSI   Apple   Audio   Printer   Modem
Adapter   Modem   Desktop   Input/
          (option   Bus   Output
          140/145)

PowerBook 160/180

Power   Internal   SCSI   Apple   Audio   Audio   Printer   Modem
Adapter   Modem   Desktop   Input   Output
          (option)   Bus

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PowerBook Duo 210/230

Internal Modem (option) — Processor-Direct Slot, 152-Pin — Power Adapter — Modem or Printer

Macintosh Duo Dock

Internal Modem (option) — Micro-phone Input — Audio Output — SCSI — Printer — Modem — Video — Apple Desktop Bus

Macintosh PowerBook Floppy Adapter

Processor-Direct Slot, 152-Pin — Apple Desktop Bus — External Floppy Drive

Macintosh Mini Duo Dock

Micro-phone Input — Audio Output — SCSI — Printer — Modem — Video — Apple Desktop Bus — External Floppy Drive

Cable Connectors

The pin numbers shown below are for the connectors attached to the ends of the Macintosh peripheral cables, as viewed from the front of the connector.

Apple AAUI
1   7
8   14

HDI-30
30   25
24   19
18   13
12   7
6   1

13-Pin, Mixed-
Contact D-Connector
A1   1   5   A2   A3
6   10

DIN-5
1   5

DE-9
1   5
6   9

Mini DIN-4
3   4
2   1

DA-15
1   8
9   15

DB-19
1   10
11   19

Mini DIN-8
7
6   8
3   5
1   2
4

DB-25
1   13
14   25

BR-50
1   25
26   50

Peripheral Cables

Peripheral Cables

Device	Part Number (Macintosh 128K & 512K)	Part Number (Macintosh Plus & Later)	Cable Model Number	Cable Color	Cable Type
ImageWriter, ImageWriter 15-inch, AppleLine, Cluster Controller	590-0169	590-0169 and 699-0430 590-0553 or 590-0341	M0150 M0199 M0189	Medium Brown Smoke Beige	DE-9 to DB-25 Male to Male Mini DIN-8 to Mini DE-9 Male to Female (adapter cable)
ImageWriter II, II/L, II/LQ; Apple Personal Modem; Apple Data Modem 2400; StyleWriter	590-0551 or 590-0332	590-0552 or 590-0340	M0196 M0185 M0197	Smoke Beige Smoke Beige	Mini DIN-8 to DE-9 Male to Male Mini DIN-8 to Mini DIN-8 Male to Male
AppleFax Modem		590-0552 or 590-0340	M0197	Smoke Beige	Mini DIN-8 to Mini DIN-8 Male to Male
Modem 300/1200	590-0197	590-0197 and 699-0430 590-0553 or 590-0341	M0170 M0199 M0189	Medium Brown Smoke Beige	DE-9 to DE-9 Male to Male Mini DIN-8 to Mini DE-9 Male to Female (adapter cable)
SCSI Devices (system cable)		658-8031 590-0305 or 590-0345	M0206	Smoke Beige	BR-50 to DB-25 Male to Male
SCSI Devices (terminator)		658-8032 590-0304 or 590-0344	M0209	Smoke Beige	BR-50
SCSI Devices (cable extender)		658-8033 590-0307 or 590-0347	M0208	Smoke Beige	BR-50 Male to Female
SCSI Devices (peripheral I/F cable)		658-8034 590-0306 or 590-0346	M0297	Smoke Beige	BR-50 Male to Male

Pin-Outs

External Video Connector – PowerBook 160/180		
Pin	**Signal Name**	**Signal Description**
1	RED.VID	Red video
2	RED.GND	Red video ground
3	MON.ID1	Monitor ID, bit 1
4	VSYNC/	Vertical sync
5	CSYNC/	Composite sync
6	C&VSYNC.GND	Composite & vertical sync ground
7	GRN.GND	Green video ground
8	GRN.VID	Green video
9	MON.ID2	Monitor ID, bit 2
10	HSYNC.GND	Horizontal sync ground
11	MON.ID3	Monitor ID, bit 3
12	HSYNC/	Horizontal sync
13	BLU.VID	Blue video
14	BLU.GND	Blue video ground
Shell	CHASSIS GND	Chassis ground

Connector type: 14-pin, high-density female

This connector is present on the PowerBook 160 and 180.

All apple-manufactured Macintosh monitors except the 21-Inch Color Display and Two-Page Monochrome Monitor are supported.

External Video Connector – Macintosh Portable		
Pin	**Signal Name**	**Signal Description**
1	FPDATA(0)	Flat panel display data bus (bit 0)
2	FPDATA(1)	Flat panel display data bus (bit 1)
3	+5V	+5 volts DC
4	FPDATA(2)	Flat panel display data bus (bit 2)
5	FPDATA(3)	Flat panel display data bus (bit 3)
6	FPDATA(4)	Flat panel display data bus (bit 4)
7	GND	Ground
8	+5V	+5 volts DC
9	GND	Ground
10	FPDATA(5)	Flat panel display data bus (bit 5)
11	FPDATA(6)	Flat panel display data bus (bit 6)
12	FPDATA(7)	Flat panel display data bus (bit 7)
13	BATTVOLTAGE	Direct connect to main battery
14	FLM	Flat panel new frame sync
15	CL2/	Flat panel display data clock
Connector type: 15-pin, high-density, D-shaped male		

Modem and Printer Connectors – Mini DIN-8

Pin	Signal Name	Signal Description
1	HSKo	Handshake output; connected to SCC Data Terminal Ready
2	HSKi	Handshake input; connected to SCC Clear To Send and Transmit/Receive Clock
3	TxD-	Transmit Data (inverted); connected to SCC Transmit Data; tri-stated when Request To Send is deasserted
4	SG	Signal Ground; connected to logic and chassis ground
5	RxD-	Receive Data (inverted); connected to SCC Receive Data
6	TxD+	Transmit Data; connected to SCC Transmit Data; tri-stated when Request To Send is deasserted
7*	GPi	General-Purpose input; connected to SCC Data Carrier Detect
8	TxD+	Receive Data; connected to SCC Receive Data

Connector type: Mini DIN-8 male

This connector is present on all Macintosh computers except the 128K, 512K, and 512 enhanced.

To connect DE-9 cables to the Mini DIN-8 port, use adapter cable 590-0341 (beige) or 590-0553/699-0430 (smoke).

*On serial port A (modem), if the VIA1 SYNC signal is high, this input will be routed to the receive/transmit clock input of the SCC. This clock input supports high-speed synchronous devices. Pin 7 is not connected on the Macintosh Plus, LC, or IIsi.

Modem and Printer Connectors – DE-9		
Pin	Signal Name	Signal Description
1	GND FG	Signal ground Frame ground
2	+5V NC	+5 volts No connection
3	GND SG	Signal ground Signal ground
4	TXD+ NC	Transmit Data + No connection
5	TXD- TXD	Transmit Data - Transmit Data
6	+12V NC	+12 volts No connection
7*	HSKi NC	Handshake input No connection
8**	RXD+ NC	Receive Data + No connection
9	RXD- RXD	Receive Data - Receive Data

Connector type: DE-9 male

This connector is present on the Macintosh 128K, 512K, and 512K enhanced.

The upper set of signal names and descriptions listed applies to RS-422. The lower set applies to RS-232.

*When connecting to an RS-232 device, use HSKi with data set ready (DSR) or other handshaking signals, depending on the device to be connected.

**When connecting to an RS-232 device, connect pin 8 to pin 3 (ground).

SCSI Connector – DB-25		
Pin	**Signal Name**	**Signal Description**
1	REQ/	Request
2	MSG/	Message
3	I/O/	Input/output
4	RST/	Reset
5	ACK/	Acknowledge
6	BUSY/	Busy
7	GND	Signal ground
8	Data0/	Data bit 0
9	GND	Signal ground
10	Data3/	Data bit 3
11	Data5/	Data bit 5
12	Data6/	Data bit 6
13	Data7/	Data bit 7
14	GND	Signal ground
15	C/D/	Control/data
16	GND	Signal ground
17	ATN/	Attention
18	GND	Signal ground
19	SEL/	Select
20	PARITY/	Data parity
21	Data1/	Data bit 1
22	Data2/	Data bit 2
23	Data4/	Data bit 4
24	GND	Signal ground
25*	TERMPWR	+5 volts terminator power

Connector type: DB-25 male

This connector is present on all Macintosh computers (including the Duo Dock) except the 128K, 512K, 512K enhanced, and PowerBook series.

Total length of cables should not exceed 20 feet (6 meters).

CAUTION: This interface uses the same type of connector as a standard RS-232 serial interface but is electrically very different. DO NOT connect RS-232 devices or cables to this port. Doing so can damage the device and the computer.

*Terminator power is not provided on the Macintosh Plus or Portable.

SCSI Connector – HDI-30		
Pin	Signal Name	Signal Description
1	SCSI–Mode/	SCSI disk mode enable signal
2	Data0/	Data bit 0
3	GND	Signal ground
4	Data1/	Data bit 1
5*	Termpwr	+5 volts termination power
6	Data2/	Data bit 2
7	Data3/	Data bit 3
8	GND	Signal ground
9	ACK/	Acknowledge
10	GND	Signal ground
11	Data4/	Data bit 4
12	GND	Signal ground
13	GND	Signal ground
14	Data5/	Data bit 5
15	GND	Signal ground
16	Data6/	Data bit 6
17	GND	Signal ground
18	Data7/	Data bit 7
19	PARITY/	Data parity
20	GND	Signal ground
21	REQ/	Request
22	GND	Signal ground
23	BUSY/	Busy
24	GND	Signal ground
25	ATN/	Attention
26	C/D/	Control/data
27	RST/	Reset
28	MSG/	Message
29	SEL/	Select
30	I/O/	Input/output

Connector: 30-pin, high-density interconnect (HDI-30)

This connector is present on the Macintosh PowerBook series (except the Duo 210/230). This connector is not present on the Macintosh Duo Dock or Macintosh Duo MiniDock.

*Termination power is not provided on the PowerBook 100.

Apple Desktop Bus Connector		
Pin	**Signal Name**	**Signal Description**
1	Data	Bidirectional data bus
2*	Power On/	Signal momentarily grounded to pin 4 to begin power-up sequence in CPU
3	Power	+5 volts
4	Ground	Signal ground

Connector type: Mini DIN-4 male

This connector is present on all Macintosh computers except the 128K, 512K, 512K enhanced, and Plus.

Total length of all cables should not exceed 16 feet (5 meters).

*On the Macintosh II family, Quadra 700 and 900, and PowerBook series only. Pin 2 is unused on all other models.

Mouse Connector		
Pin	**Signal Name**	**Signal Description**
1	GND	Signal ground
2	+5V	+5 volts DC
3	GND	Signal ground
4	X2	Left-to-right motion indicator
5	X1	Interrupt line (left-to-right motion)
6	NC	No connection
7	SW	Mouse button
8	Y2	Up-down motion indicator
9	Y1	Interrupt line (up-down motion)

Connector type: DE-9 male

This connector is present on the Macintosh 128K, 512K, 512K enhanced, and Plus.

Keyboard Connector		
Pin	**Signal Name**	**Signal Description**
1	GND	Ground
2	CLOCK	Keyboard clock (input to VIA)
3	DATA	Serial data line
4	+5V	+5 volts

Connector type: RJ-11

This connector is present on the Macintosh 128K, 512K, 512K enhanced, and Plus.

External Floppy Drive Connector – DB-19		
Pin	**Signal Name**	**Signal Description**
1	GND	Signal ground
2	GND	Signal ground
3	GND	Signal ground
4	GND	Signal ground
5	-12V	-12 volts DC
6	+5V	+5 volts DC
7	+12V	+12 volts DC
8	+12V	+12 volts DC
9	NC	No connection
10	PWM	Motor speed control
11	PH0	Command control line
12	PH1	Command control line
13	PH2	Command control line
14	PH3	Command control line
15	WRREQ/	Write request
16	HDSEL	Hand select
17	ENBL2/	Read line enable
18	RD	Read data
19	WR	Write data

Connector type: DB-19 male

This connector is present on the 128K, 512K, 512K, 512K enhanced, Plus, SE, SE/30, Classic, Classic II, Performa 200, Portable, IIcx, IIci, IIsi, IIvi, IIvx, and Performa 600.

A Macintosh 400K External Drive can be connected to the 128K, 512K, 512K enhanced, Plus, SE, and Portable.

A Macintosh 800K External Drive or an Apple 3.5" Drive can be connected to the 512K enhanced, Plus, SE, SE/30, Classic, Classic II, Performa 200, IIcx, IIci, IIsi, Portable, IIvi, IIvx, and Performa 600.

Connect an Apple SuperDrive to a Macintosh SE (FDHD upgrade), SE/30, Classic, Classic II, IIcx, IIci, IIsi, Portable, IIvi, IIvx, and Performa 600.

Connect a Hard Disk 20 to a Macintosh 512K, 512K enhanced, Plus, and SE.

External Floppy Drive Connector – HDI-20		
Pin	Signal Name	Signal Description
1	GND	Signal ground
2	GND	Signal ground
3	GND	Signal ground
4	GND	Signal ground
5	NC	No connection
6	+5V	+5 volts DC
7	+5V	+5 volts DC
8	+5V	+5 volts DC
9	+5V	+5 volts DC
10	NC	No connection
11	PH0	Phase 0
12	PH1	Phase 1
13	PH2	Phase 2
14	PH3	Phase 3
15	WREQ/	Write request
16	HDSEL	Head select
17	ENBL2/	External drive select
18	RD	Read data
19	WR	Write data
20	NC	Not connected

Connector: 20-pin, high-density interconnect (HDI-20)

This connector is present on the Macintosh Duo MiniDock, PowerBook 100, and PowerBook Duo Floppy Adapter.

An HDI-20 1.4 MB drive can be connected to this port.

Audio Output Connector – Stereo*

Pin	Signal Name	Signal Description
(Sleeve)	GND	Signal ground
(Tip)	Left	1-volt, peak-to-peak audio signal with an impedance of 47 ohms**; left channel
(Ring)	Right	1-volt, peak-to-peak audio signal with an impedance of 47 ohms; right channel

Connector type: Stereo miniature phone plug (3.6 mm)

This connector is present on the Macintosh SE/30, Classic, Classic II, Performa 200, II, IIx, IIfx, IIcx, IIci, Quadra 700, Quadra 900, Quadra 950, LC, LC II, Performa 400, IIsi, Portable, and PowerBook series (except the Duo 210/230).

The internal speaker is disabled when this connector is in use.

*The PowerBook 100 outputs a monaural signal on the left and right channels.

**The Macintosh Portable and PowerBook series produce a 0.75-volt, peak-to-peak signal.

Audio Output Connector – Monaural

Pin	Signal Name	Signal Description
(Tip)	AUDIO	.5-volt, peak-to-peak audio signal
(Sleeve)	GND	Signal ground

Connector type: Monaural miniature phone plug (3.6 mm)

This connector is present on the Macintosh 128K, 512K, 512K enhanced, Plus, and SE.

The internal speaker is disabled when this connector is in use.

Microphone Input Connector

Pin	Signal Name	Signal Description
(Tip)	+8V	+8 volts for powering electret microphone*
(Ring)	Right	Audio input with a maximum amplitude of 20 mV at 600 ohms impedance
(Sleeve)	GND	Signal ground

Connector type: Stereo miniature phone plug (3.6 mm)

This connector is present on the Macintosh LC, LC II, Performa 400, IIsi, Classic II, Performa 200, IIvi, IIvx, Performa 600, Quadra 700, Quadra 900, Quadra 950, PowerBook 140,145,160,170,180, and Duo Dock.

*Do not connect any device other than the Macintosh microphone into the microphone input connector. The connector provides +8 volts for the microphone. Connecting incompatible devices could damage the device or computer.

Macintosh 128K, 512K, and Plus

Illustrated Parts List

Internal Drive Shield

CRT and Yoke Assembly

CRT Socket Cable

400K/800K Floppy Drive

Front Bezel

Internal Drive Cable

Insulator Shield

Power/ Sweep Board

Chassis

462-3100
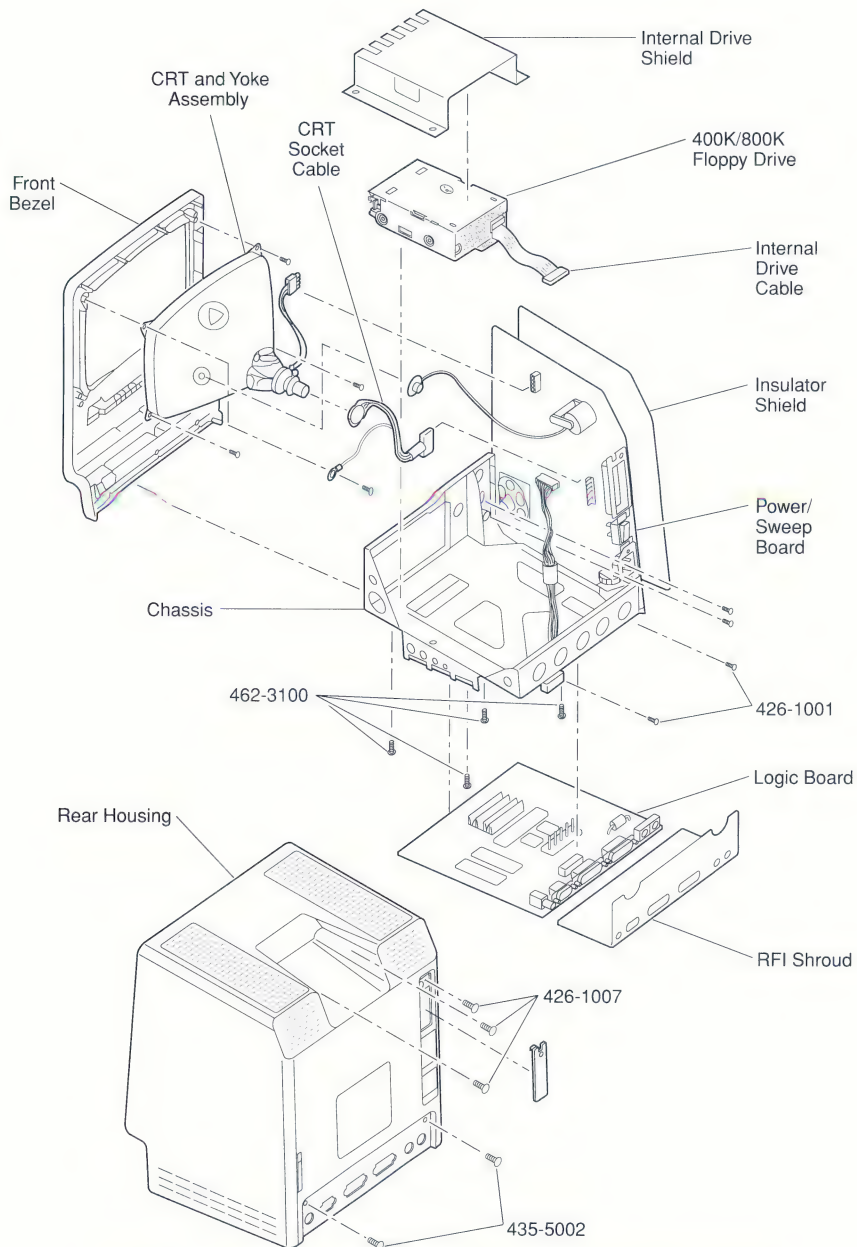
426-1001

Logic Board

Rear Housing

RFI Shroud

426-1007

435-5002

Figure 1   Macintosh 128K, 512K, and Plus Exploded View

Macintosh 128K and 512K only

Drive, Apple 3.5", internal 400K mechanism 661-76156

    Internal drive cable, 3.5" (red stripe – also 800K drive) 590-0167

    Internal drive shield..805-0765

Front bezel, Macintosh, beige...810-0373

    Logo label (bezel) 825-0547

Keyboard, beige..661-96154

    Cable, keyboard/keypad, beige 590-0144

    Keyboard bottom case...815-0754

    Keyboard top case...815-0728

    Keycap set...658-7039

    Keyswitch, Alps alpha lock 705-0077

    Keyswitch, Alps long-stem..705-0070

    Screw, tap 2.20 x 6.25 (keyboard case) 430-1025

Logic board, 128K...661-96152

Logic board, 512K...661-96236

    Battery, alkaline, 4.5 V..742-0003

    RFI shroud, Macintosh..805-0577

    ROM, high, rev. B, Macintosh with 400K floppy drive..............661-0220

    ROM, low, rev. B, Macintosh with 400K floppy drive 661-0221

    ROM, high, Macintosh with 800K floppy drive 661-0632

    ROM, low, Macintosh with 800K floppy drive 661-0633

Rear housing with label 630-5139

    Agency approval label 825-4018

    Agency approval label, 512K...825-1014

    Logo label (housing) 825-0613

    Macintosh battery door, beige 815-0938

    Macintosh foot, platinum (beige foot not available) 865-0051

    Macintosh label...825-0742

    Macintosh signature 128K label..825-1064

    Macintosh signature 512K label..825-1065

Macintosh Plus only

Cable, peripheral adapter, smoke...699-0430

Front bezel, beige 810-0379

Front bezel, platinum 810-0385

    Ground clip 805-0910

    Logo label (bezel) 825-0547

Keyboard assembly

    Keyboard, beige 661-0322

    Keyboard, platinum (with cable) 661-0416

    Bottom cover, beige..815-0937

    Bottom cover, platinum 815-0984

Macintosh 128K, 512K, and Plus

Drive, Apple 3.5", 800K mechanism (512Ke and Plus) 661-0345
    Internal drive cable, 3.5" (yellow stripe) 590-0437
    Internal drive shield (512K enhanced and Plus) 805-0217
    Packing disk, 2-sided (for transporting) 003-0003
Keyboard, foreign language C661-0297
Mouse, Macintosh, beige...661-96155
    Mouseball retainer 815-0409
    Rubber-coated mouseball...699-8001
Power cable, smoke, 110 VAC 590-0380
Power supply, 110 V, beige 661-0461
Power/sweep board, 220 V..661-76214
    Brightness knob, platinum 865-0029
    Cable, power supply to logic board..590-0511
    Fuse, power supply, int'l, 1.6 A 250 V 740-0060
    Fuse, power supply, U.S., 2.5 A 250 V....................................740-0300
    Ground clip, lower..805-0576
    Ground clip, upper 805-0575
    Insulator shield (back of power supply) 725-0011
    Screw, M 2.9 x 10 470-2101
Rear housing
    Macintosh foot, platinum (beige foot not available) 865-0051
    Reset/interrupt switch, beige 815-0737
    Screw, tap, 8-32 x .625, Torx, blk zinc oxide (case bottom) 435-5002
    Screw, tap, M 4.22 x 1.41 x 16, Torx, zinc (case top)..............426-1007
Screw, M 2.9 x 6 470-2100
Screw, sem 4-40 x 3/8 440-4105
Service packaging, 800K/1.4 MB drives 602-0210

Specifications

Processor	Motorola 68000 microprocessor 32-bit internal data bus 7.83 MHz

Memory	RAM: Macintosh–128K or 512K
	    Macintosh Plus–1 MB, expandable to 4 MB (120 ns or faster SIMMs)
	ROM: Macintosh–64K
	    Macintosh Plus–128K
	Clock: CMOS custom chip with 4.5 V, user-replaceable battery
	    backup (includes 256 bytes of memory; remembers system
	    parameters even with the machine switched off)

Disk Storage	Macintosh–Internal single-sided floppy drive that uses 3.5 in., hard-
	    case, 400K floppy disks
	Macintosh Plus–Internal double-sided floppy drive that uses 3.5 in.,
	    hard-case, double-sided 800K or single-sided 400K floppy disks

I/O Interfaces	Serial: Macintosh–Two RS-232/RS-422 serial ports; DE-9 connectors Macintosh Plus–Two RS-422 serial ports; mini DIN-9 connectors Mouse: Mouse port; DE-9 connector Keyboard: Synchronous serial keyboard bus; RJ-11 connector Drive: External drive port; DB-19 connector SCSI: Macintosh Plus–One SCSI parallel port; DB-25 connector

I/O Devices	Keyboard: Macintosh–58 keys; software mapped; RJ-11 connector
	    Macintosh Plus–78 keys, including numeric keypad and cursor
	    keys; RJ-11 connector
	Mouse: Mechanical tracking; optical shaft encoding at 3.54 pulses
	    per mm (90 pulses per in.) of travel; DE-9 connector

Sound and Video	Video display: 9-in. (diagonal) screen; 512 by 342 pixel, bit-mapped
	    display
	Sound generator: Four-voice sound with 8-bit digital/analog
	    conversion, using 22-kHz sampling rate

Electrical	Line voltage: 105–125 VAC Frequency: 50–60 Hz Maximum power: 60 W
Physical	Height: 13.6 in. (34.5 cm) Width: 9.6 in. (24.4 cm) Depth: 10.9 in. (27.6 cm) Weight: 16 lb. 8 oz. (7.5 kg)

Symptom/Cure Chart

Video Problems	**Solutions**
No video, but audio tone is present and drive operates	1. Turn contrast control fully clockwise. 2. Check video cable. 3. Replace neck cable. 4. Replace power/sweep board. 5. Replace logic board. Retain customer's SIMMs.
Screen is bright and audio is present, but no video information is present	1. Replace power/sweep board. 2. Replace logic board. Retain customer's SIMMs.

Drive Problems	**Solutions**
Disk ejects; display shows disk icon with blinking "X"	1. Replace bad disk. 2. Replace disk drive cable. 3. Replace disk drive. 4. Replace logic board. Retain customer's SIMMs.
Unable to insert disk all the way	1. Power off system and hold mouse button down while switching power back on to ensure eject cycle has been completed. 2. Replace disk drive.
Drive doesn't eject disk	1. Hold down <Shift> and <Command> keys and press 1 (for the internal drive) or 2 (for external drive). 2. Choose **Eject** from File menu. Attempt this 2 to 3 times. 3. Eject disk manually by pushing opened paper clip into hole beside drive slot. 4. Replace disk drive.
Doesn't read disks on internal or external drive	1. Replace bad disk. 2. Replace disk drive cable. 3. Replace Mylar RFI shield. 4. Replace disk drive. 5. Verify ROMs on logic board. 6. Replace logic board. Retain customer's SIMMs.
Audio tone sounds at power on, video is present, but drive doesn't operate	1. Replace disk drive cable. 2. Replace disk drive. 3. Replace logic board. Retain customer's SIMMs.
Drive continually ejects disk	1. Check disk drive cable. See compatibility table in *Monitors and Mass Storage Service Guide*. 2. Replace disk drive.
Disk drive runs continuously	1. Replace bad disk. 2. Replace disk drive cable. 3. Replace disk drive. 4. Replace logic board. Retain customer's SIMMs.

| 400K drive won't boot | 1. If logic board has Rev. A ROMs and drive stepper motor is serial number F518 or higher, upgrade to Rev. B ROMs. |
| | 2. Replace disk drive. |

Peripheral Problems	**Solutions**
Cursor doesn't move	1. Connect mouse.
	2. Replace mouse.
	3. Replace logic board. Retain customer's SIMMs.
Cursor moves but clicking mouse produces no response	1. Replace mouse.
	2. Replace logic board. Retain customer's SIMMs.
No response to any key on the keyboard	1. Replace keyboard cable.
	2. Replace keyboard.
	3. Replace logic board. Retain customer's SIMMs.
No response from a particular key	1. Replace keyswitch.
	2. Replace keyboard.
	3. Replace logic board. Retain customer's SIMMs.
Known-good ImageWriter or ImageWriter II doesn't print	1. Make sure Chooser and Control Panel are set correctly.
	2. Replace software with known-good software.
	3. Replace printer interface cable.
	4. Replace logic board. Retain customer's SIMMs.
Known-good LaserWriter doesn't print	1. Make sure Chooser and Control Panel are set correctly.
	2. Replace software with known-good software.
	3. Refer to *LaserWriter Printers Service Guide*.

Miscellaneous Problems	**Solutions**
When turned on, Macintosh Plus continuously beeps and tries to power up	1. Check power/sweep voltage.
	2. Replace power/sweep board, logic board, and internal drive; then turn on Macintosh Plus. **Replacing only the power/ sweep board may damage new power/sweep board.**
Clicking or chirping sound	1. Connect logic board cable.
	2. Perform voltage adjustment.
	3. Replace power/sweep board.
	4. Replace logic board. Retain customer's SIMMs.
No video, no audio tone, and no drive operation	1. Connect power cord.
	2. Turn power on.
	3. Replace power cord.
	4. Check fuse.
	5. Replace power/sweep board.
	6. Replace logic board. Retain customer's SIMMs.

Smoke/odor issues from computer	–	Replace power/sweep board.
MacTest displays 128K/512K when 1 MB Macintosh Plus is tested	–	Replace Macintosh Plus logic board.
When developer's switch is installed, Macintosh Plus resets intermittently	–	Remove switch and file end 1/16 of an inch.
Macintosh Plus hangs on startup	–	Check ROMs. If ROMs 342-0341-A or B (ROM HI) and 342-0342-A (ROM LO) are installed on logic board and peripheral device is connected to SCSI port, turn on peripheral device before switching on computer.
Macintosh 512K enhanced has two RFI shrouds	–	Some machines have two RFI shrouds installed. Replace two RFI shrouds with one RFI shroud.

Adjustments

▲ Warning	The following adjustments are performed with the power on. Review CRT safety rules before performing these procedures.

Power/Sweep Voltage Adjustment

Verify correct voltages whenever you replace the logic board or power/sweep board. If the voltages are outside specified tolerances, perform the voltage and video adjustments.

1. Switch off power, disconnect the power cord, and disconnect any peripheral devices.

▲ Warning	When using the voltmeter, pull the insulating rubber hoods over the test probes so that the banana-plug test probes do not short to one another.

2. Connect the voltage test cable to the external drive port at the rear of the computer.
3. Use the voltmeter and **orange** test cable as follows:
    a. Connect the **black** voltmeter lead between the voltmeter ground terminal and the computer chassis.
    b. Connect the **orange** test cable lead (12-volt lead) to the voltage input terminal on the voltmeter.
    c. Connect the power cord and switch on the computer.
    d. If the voltage reading is not between 11.9 and 12.75 volts, adjust the voltage regulator (Figure 2).
4. Switch off the computer power and disconnect the orange lead.
5. Connect the **red** test cable lead (5-volt lead) to the voltage input terminal and switch on the computer. If the voltage reading is not 5 volts ($\pm$ .15 volts), adjust the voltage regulator (Figure 2).
6. Repeat steps to verify correct voltages. Replace the power/sweep board if you cannot attain correct voltages.

Voltage Regulator

Figure 2   Voltage Adjustment Control

Tilt Adjustment

1. Remove the cover and discharge the CRT. Turn the computer so that the back is facing you, and place a mirror in front of the CRT screen.
2. Loosen the yoke clamp screw (Figure 3) two or three turns.
3. Connect the power cord and switch the power on.
4. Place one hand behind your back, and with your other hand grasp only the plastic spokes of the yoke collar (Figure 3). Rotate the yoke collar until the top and bottom edges of the picture appear parallel with the top and bottom edges of the bezel. **(Do not move the magnets, which are preset by the manufacturer and should not be adjusted.)**
5. Switch the power off, unplug the computer, and discharge the CRT.
6. Hold the yoke collar in position and tighten the yoke clamp screw so that the yoke collar (Figure 3) will not slip. Don't overtighten.
7. Connect the power cord and switch the power on to verify that the adjustment is still correct.

Figure 3   CRT Adjustment Controls

Centering Ring Adjustment

1. Remove the cover and discharge the CRT. Turn the computer so that the back is facing you, and place a mirror in front of the CRT screen.
2. Locate the two centering rings on the yoke assembly (Figure 3). If a bonding material is holding the rings in place, use a small knife to break the bonding.
3. Connect the power cord and switch the power on.
4. Rotate each ring about half a turn and observe the effect on the screen. The adjustment of the centering rings determines whether the picture is centered or offset to one side.
5. Center the picture by first holding the front ring steady and moving the rear ring, then holding the rear ring steady and moving the front ring.

Brightness and Contrast Adjustment

1. Remove the cover and discharge the CRT. Turn the computer so that the back is facing you and place a mirror in front of the CRT screen.
2. Connect the power cord and switch the power on.
3. Turn the user brightness knob (Figure 4) fully clockwise.

Figure 4   Video Adjustment Controls

4. Using the alignment tool, turn the brightness control (Figure 4) fully counterclockwise so that white lines are visible on the screen. Then turn the brightness control clockwise until the white lines just disappear.
5. Turn the user brightness knob slightly counterclockwise to achieve the ideal brightness and contrast adjustment.

Size Adjustment

1. Use the plastic alignment tool to adjust the width adjustment (Figure 4) until the raster is approximately 7 inches wide.
2. Use the alignment tool to adjust the height adjustment (Figure 4) until the raster is approximately 4.7 inches high.

Focus Adjustment

1. Launch any application or document to fill the screen with information.
2. Turn the focus adjustment (Figure 4) fully clockwise. Then turn the focus adjustment back (counterclockwise) one-eighth of a turn and adjust for best overall focus.

Things to Remember

- Before working inside the computer, discharge the CRT to the metal ground lug. Failure to do so can result in damage to the logic and power/sweep boards (see "Discharging and Devacuuming the CRT"). Use the CRT discharge tool.
- After installing the Disk Drive Kit, return the old ROMs and the 400K drive to Apple.
- After installing the Logic Board Kit, return the 128K/512K logic board, the old RFI shield, and the old cover to Apple.

800K Drive Kit Installation Procedure

1. Remove the cover and the RFI shield, and discharge the CRT to the metal ground lug.
2. Remove the logic board. Using an IC extractor, remove the two ROMs installed at locations D5 and D8.
3. Install the two new ROMs in the appropriate locations on the logic board. The notch at the end of each ROM should face the front of the machine.

ROM	P/N	Location
HI	342-0341	D5
LOW	342-0342	D8

4. Remove the internal drive.
5. Install the logic board and the new 800K internal drive.
6. Install the RFI shield and the cover.

Logic Board Kit Installation Procedure

1. Remove the cover and the RFI shield, and discharge the CRT to the metal ground lug.
2. Remove the 128K/512K logic board. Using an IC extractor, remove the two ROMS installed at locations D5 and D8.
3. Install the ROMs in the appropriate locations on the new 1 MB logic board. The notch at the end of each ROM should face the front of the machine.

ROM	P/N	Location
HI	342-0341	D5
LOW	342-0342	D8

4. Install the new 1 MB logic board, the new RFI shield, and the new cover.

Macintosh Plus RAM Upgrade

The Macintosh Plus requires 150 ns (or faster) SIMMs. RAM speed is indicated by the -xx number after the manufacturer's part number (-15 indicates a 150 ns SIMM). SIMMs are available in 256K and 1 MB RAM sizes. To add memory to a Macintosh Plus, refer to Figure 5 and follow the steps below.

Figure 5   Macintosh Plus Logic Board (1 MB)

1. Clip or install the needed resistor (see table below).
2. Remove/install the needed SIMMs (see table below). Use the SIMM removal tool.

RAM, Resistor, and SIMM Compatibility

RAM	Resistors	SIMMs
1 MB	R8 installed R9 removed	Two 256K SIMMs (Bank A) Two 256K SIMMs (Bank B)
2.5 MB	R8 removed R9 removed	Two 1 MB SIMMs (Bank A) Two 256K SIMMs (Bank B)
4 MB	R8 removed R9 removed	Two 1 MB SIMMs (Bank A) Two 1 MB SIMMs (Bank B)

ROM Upgrade Procedure

To be compatible with the current 400K drive stepper motor, the Macintosh 128K and 512K need ROM HI 342-0220-B at location D5, and ROM LOW 342-0221-B at location D8. If these ROM chips are not installed, upgrade the logic board by replacing the boot ROM chips as explained below.

▲ Warning **Failure to follow the rules for safe CRT discharge could result in serious injury or property damage. The Macintosh CRT must be discharged to the ground lug to prevent damage to the logic board.**

1. Power off the computer, remove the power cord and cover, and discharge the CRT. Use the CRT discharge tool.
2. Put on your grounding wriststrap and place the Macintosh on a grounded workbench pad.
3. Remove the logic board and verify that old ROM chips are installed.
4. Using an IC extractor, remove the old ROM chips.
5. Install the new ROM chips in the appropriate location—ROM HI (P/N 342-0220-B) at location D5, ROM LOW (P/N 342-0221-B) at location D8. The notch at the end of each ROM should face the front of the machine.
6. Replace the Macintosh logic board and the cover.
7. Run *MacTest* to verify correct operation.

ROM Compatibility for 800K Drives

The 512K logic board (P/N 661-96236) ships with a high-boot ROM (P/N 342-0220) and a low-boot ROM (P/N 342-0221) that support only the 400K drive. When you use a 512K logic board to replace a defective 512K enhanced logic board or a defective 512K logic board with an 800K drive, you must replace the ROM chips on the replacement 512K logic board with ROM chips from the customer's logic board. The customer's ROM chips, which support the 800K drive, will have part numbers 342-0341 (high-boot ROM) and 342-0342 (low-boot ROM).

Also, newer Macintosh 512K enhanced and Macintosh Plus systems and the 800K disk drive upgrade kit have revised high-boot and low-boot ROM chips that correct the SCSI device problems of older ROM chips. The newer ROM chips are compatible with 512K systems, but you cannot mix old and new ROM chips. This list gives the part number and the version letter of the old and new ROM chips:

	Old ROM Chips	New ROM Chips
High Boot:	342-0341-A 342-0341-B	342-0341-C
Low Boot:	342-0342-A	342-0342-B

Logic Board Diagrams

Figure 6   Macintosh 128K/512K Logic Board

Figure 7   Macintosh Plus Logic Board

Macintosh 128K, 512K, and Plus

Macintosh SE
and SE/30

Illustrated Parts List

Figure 1   Macintosh SE and SE/30 Exploded View

Specifications—Macintosh SE

Processor	Motorola 68000 microprocessor 32-bit internal data bus 7.83 MHz
Memory	RAM: 1 or 2 MB, expandable to 4 MB ROM: 256K PRAM: 256 bytes Clock: CMOS custom chip with long-life lithium battery

Disk Storage	Internal: 800K or 1.4 MB floppy drive
	    Either a second 1.4 MB floppy drive or a 20 or 40 MB internal hard
	    drive
	External: Optional second or third floppy drive or hard drives

I/O Interfaces	ADB: Two ADB connectors for communication with keyboard, mouse,
	    and other input devices
	Serial: Two RS-232/RS-422 serial ports; 230.4 Kbaud maximum; mini
	    DIN-8 connectors
	External drive: Macintosh SE expansion slot; 96-pin Euro-DIN
	    connector
	SCSI: SCSI port uses a 50-pin internal connector and a DB-25
	    external connector
	Sound: For external audio amplifier (standard miniature)

I/O Devices	Keyboard: Apple Keyboard with 81 keys, including numeric keypad
	    and cursor keys
	    Apple Extended Keyboard with 105 keys, including 15 function
	    keys, separate cursor pad, 10-key numeric keypad; ADB
	    connector
	Mouse: Mechanical tracking; optical shaft encoding at 3.94 pulses per
	    mm (100 pulses per in.) of travel; ADB connector

Sound and Video	Video display: 9-in. (diagonal) screen; high-resolution, 512 by 342
	    pixel, bit-mapped display
	Sound generator: Four-voice sound with 8-bit digital/analog
	    conversion, using 22-kHz sampling rate

Electrical	Line voltage: 90–140 VAC; 170–270 VAC Frequency: 47–63 Hz Maximum power: 100 W
Physical	Height: 13.6 in. (34.5 cm) Width: 9.6 in. (24.4 cm) Depth: 10.9 in. (27.6 cm) Weight: 17–21 lb. (7.7–9.5 kg) depending on whether hard drive or second floppy drive is installed

Specifications—Macintosh SE/30

Processor	Motorola 68030 microprocessor 32-bit internal architecture 15.667 MHz Built-in paged memory management unit (PMMU) 256-byte instruction and data caches Motorola 68882 floating-point unit (follows IEEE standards)
Memory	RAM: 1 or 4 MB, expandable to 8 MB (expandable to 128 MB when SIMMs with higher-density DRAM chips become available); additionally expandable through 030 direct slot. ROM: 256K PRAM: 256 bytes of user-settable parameter memory Clock: CMOS custom chip with long-life lithium battery
Disk Storage	Floppy drive: 1.4 MB floppy drive Hard drive: Optional 40 or 80 MB hard drive
I/O Interfaces	ADB: Two ADB ports for communication with keyboard, mouse, and other input devices over low-speed synchronous serial bus 68030 direct slot: Supporting full 32-bit address and data lines through 120-pin Euro-DIN connector Serial: Two RS-232/RS-422 serial ports; 230.4 Kbaud maximum Sound: Stereo sound port for external audio amplifier
I/O Devices	Keyboard: Apple Keyboard with 81 keys, including numeric keypad and cursor keys Apple Extended Keyboard with 105 keys, including 15 function keys, separate cursor pad, 10-key numeric keypad; ADB connector Mouse: Mechanical tracking; optical shaft or contact encoding at 3.94 $\pm$ 0.39 pulses per mm (100 $\pm$ 10 pulses per in.) of travel; ADB connector
Sound and Video	Video display: 9-in. (diagonal) screen; high-resolution, 512 by 342 pixel, bit-mapped display Color QuickDraw™ in ROM provides support for gray-scale and color video cards installed in the 030 direct slot Sound generator: Apple Sound Chip (ASC) including four-voice, wave-table synthesis and stereo sampling generator capable of driving stereo mini-phone-jack headphones or other stereo equipment; mixed stereo monophonic sound output through internal speaker
Electrical	Line voltage: 120–240 VAC, RMS automatically configured Frequency: 48–62 Hz, single phase Maximum power: 75 W
Physical	Height: 13.6 in. (34.5 cm) Width: 9.6 in. (24.4 cm) Depth: 10.9 in. (27.6 cm) Weight: 21.5 lb. (9.75 kg)

Symptom/Cure Chart

Video Problems	Solutions
Screen is dark; audio and drive operate	1. Readjust brightness. 2. Check yoke cable connection. 3. Replace analog board. 4. Replace video board. 5. Replace logic board. Retain customer's SIMMs. 6. Replace CRT.
Screen is bright and audio is present but no video information is visible	1. Replace analog board 2. Replace video board. 3. Replace logic board. Retain customer's SIMMs.
Screen is completely dark and fan is not running	1. Replace power supply. 2. Replace analog board.
A single vertical or horizontal line is displayed	1. Replace analog board. 2. Replace video board. 3. Replace logic board. Retain customer's SIMMs. 4. Replace CRT.
Vertical or horizontal bars or stripes are displayed	1. Replace analog board. 2. Replace logic board. Retain customer's SIMMs.
A white dot appears in center of screen	1. Check yoke cable connection. 2. Replace analog board. 3. Replace CRT.
Screen jitters	1. Move computer away from adjacent electrical equipment that may cause interference. 2. Replace analog board.

Peripheral Problems	Solutions
Cursor doesn't move	1. Check mouse connection. 2. If mouse was connected to keyboard, connect it to rear ADB port. If mouse works, replace keyboard. If mouse does not work in any ADB port, replace mouse. 3. Replace logic board. Retain customer's SIMMs.
Cursor moves, but clicking the mouse button has no effect	1. Replace mouse. 2. Replace main logic board.
No response to any key on the keyboard	1. Check keyboard connection to rear ADB port. 2. Replace keyboard cable. 3. Replace keyboard. 4. Replace logic board. Retain customer's SIMMs.

Can't double-click to open a disk, application, or server	1. Disable Extensions. Hold down <Shift> key and reboot. 2. Remove extra system files on hard drive. 3. Clear parameter RAM. Hold down <Option> <R> <P> <Command> keys and select Control Panel from Apple menu. Reset mouse controls. 4. If mouse was connected to keyboard, connect it to rear ADB port. If mouse works, replace keyboard. 5. If mouse fails in any ADB port, replace mouse. 6. Replace logic board. Retain customer's SIMMs.
Known-good ImageWriter doesn't print	1. Make sure Chooser and Control Panel are set correctly. 2. Replace software with known-good software. 3. Replace printer interface cable. 4. Replace logic board. Retain customer's SIMMs. 5. Replace power/sweep board.
Known-good LaserWriter doesn't print	1. Make sure Chooser and Control Panel are set correctly. 2. Replace software with known-good software. 3. Refer to *Networking and Communications Service Guide* or to *Service Source*.

Drive Problems	**Solutions**
Audio and video are present, but one internal drive doesn't operate	1. Replace bad disk. 2. Replace internal drive cable. 3. Replace internal drive. 4. Replace logic board. Retain customer's SIMMs.
Audio and video are present, but neither internal drive operates	1. Replace bad disk. 2. Replace logic board. Retain customer's SIMMs.
External drive doesn't operate	1. Replace bad disk. 2. Be sure external drive is sitting to right of Macintosh. 3. Replace external drive. 4. Replace logic board. Retain customer's SIMMs.
Internal drive runs continuously	1. Replace bad disk. 2. Replace drive. 3. Replace logic board. Retain customer's SIMMs. 4. Replace drive cable.
Unable to insert disk all the way	1. Eject disk manually by pushing opened paper clip into hole beside drive. 2. Switch off system power and hold mouse button down while switching power back on (to complete eject cycle). 3. Replace drive.
Disk ejects; display shows icon with blinking "X"	1. Replace disk with known-good system disk. 2. Replace drive. 3. Replace logic board. Retain customer's SIMMs.

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Doesn't eject disk	1.	Eject disk manually by pushing opened paper clip into hole beside drive.
	2.	Power off system and hold mouse button down while powering back on (to complete eject cycle).
	3.	Replace drive.

SCSI Problems **Solutions**

Internal or external hard drive doesn't operate	1.	Verify that SCSI loopback card is not attached.
	2.	Replace hard drive cable.
	3.	Replace hard drive.
	4.	Replace logic board. Retain customer's SIMMs.

Works with internal or external SCSI device but not with both	1.	Verify that SCSI device ID switch setting on external device is higher than 0. Also verify that ID switch setting on external SCSI device does not duplicate ID switch setting on any other attached SCSI device.
	2.	Replace terminator on external device.
	3.	Verify that terminator is installed on internal SCSI drive.
	4.	Replace SCSI device select cable.

Miscellaneous Problems **Solutions**

Clicking, chirping, or thumping sound	1.	Verify that main logic board power cable is connected at J12 on main logic board.
	2.	Replace power supply.
	3.	Replace analog board.
	4.	Replace logic board. Retain customer's SIMMs.

No video, no audio, and no drive operation	1.	Connect power cord and switch power on.
	2.	Replace power cord.
	3.	Replace power supply.
	4.	Replace analog board.
	5.	Replace logic board. Retain customer's SIMMs.

| Smoke/odor | 1. | Replace power supply. |
| | 2. | Replace analog board. |

Sad Macintosh icon	1.	Replace bad floppy disk.
	2.	Replace SIMM(s) if code matches any of those on "SIMM Error Codes—Macintosh SE" chart in this section.
	3.	Verify that three-pin jumper on logic board is configured correctly for system RAM (Macintosh SE only).
	4.	Replace logic board. Retain customer's SIMMs.

| Sad Macintosh icon and black lines are displayed; screeching sound | 1. | Verify that three-pin jumper on logic board is configured correctly for system RAM (Macintosh SE only). |
| | 2. | Replace logic board. Retain customer's SIMMs. |

SIMM Error Codes—Macintosh SE

When you switch on a Macintosh SE computer, the ROM runs a series of logic board tests. If a test fails, a Sad Macintosh icon and a two-row, eight-digit error code (shown in the table below) indicates a SIMM failure. Identify the SIMM socket number for the type of logic board (the logic board has either solder-type or jumper-type resistors) in the customer's computer and replace the bad SIMM.

Macintosh SE SIMM Error Codes

Error Code[1]	SIMM on Soldered Board[2]	SIMM on Jumpered Board[3]	Error Code[1]	SIMM on Soldered Board[2]	SIMM on Jumpered Board[3]
0000000E 000000XX	1	3	00000003 0000XX00	2	4
0000000E 00XX00XX	1	3	00000003 XX00XX00	2	4
0000000E 0000XX00	2	4	00000004 000000XX	3	1
0000000E XX00XX00	2	4	00000004 00XX00XX	3	1
00000002 000000XX	1	3	00000004 0000XX00	4	2
00000002 00XX00XX	1	3	00000004 XX00XX00	4	2
00000002 0000XX00	2	4	00000005 000000XX	3	1
00000002 XX00XX00	2	4	00000005 00XX00XX	3	1
00000003 000000XX	1	3	00000005 0000XX00	4	2
00000003 00XX00XX	1	3	00000005 XX00XX00	4	2

1 Paired XXs in the error codes indicate any number except 0. If the error code is unreadable, press the reset switch and watch carefully—the error code will appear briefly. If the error code is still unreadable, try replacing SIMMs.
2 This column applies to Macintosh SE computers with solder-type resistors on the logic board. See "Memory Upgrade—Macintosh SE" later in this section.
3 This column applies to Macintosh SE computers with jumper-type resistors on the logic board. See "Memory Upgrade—Macintosh SE" later in this section.

Video Adjustments

Although the exact location of the adjustment controls differs slightly, the procedures for performing yoke and video adjustments are the same on the Macintosh SE and SE/30 as on the Macintosh and Macintosh Plus. Refer to the Macintosh 128K, 512K, and Plus chapter for these adjustments.

Memory Upgrade—Macintosh SE

Two logic boards are available for the Macintosh SE. The original logic board uses solder-type resistors to identify system memory configurations; the revised logic board uses a jumper. Also note that memory configurations requiring only two SIMMs use SIMM slots 1 and 2 on the original board, but use slots 3 and 4 on the revised board. The Macintosh SE requires 150 ns or faster SIMMs (indicated by the -xx number after the manufacturer's part number).

Upgrade Procedure—Solder-Type Resistors

1. Clip or install the needed resistor (see the chart and figure below).
2. Install the SIMMs as indicated in the chart below.

Macintosh SE SIMM/Resistor Configurations

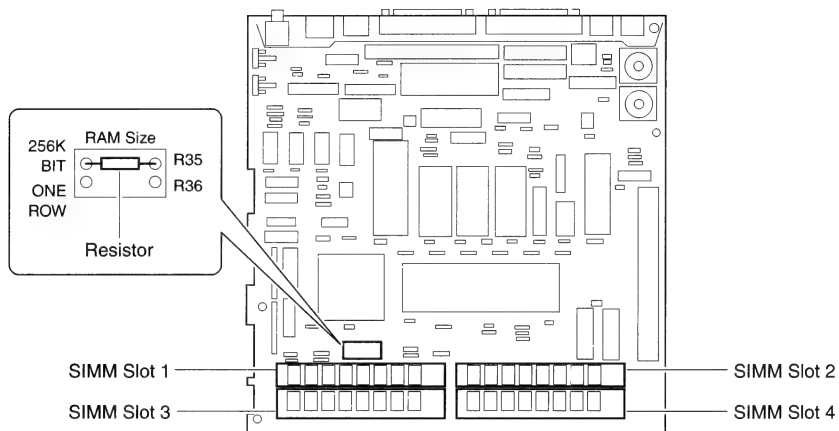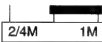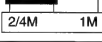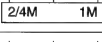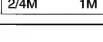| RAM	Resistors	SIMMs
1 MB	R35 installed R36 removed	Four 256K SIMMs
2 MB	R35 removed R36 installed	Two 1 MB SIMMs (slots 1 &2)
2.5 MB	No resistors	Two 1 MB SIMMs (slots 1 & 2) Two 256K SIMMs (slots 3 & 4)
4 MB	No resistors	Four 1 MB SIMMs

Figure 2   Macintosh SE Solder-Type Logic Board

Upgrade Procedure—Jumper-Type Resistors

1. Move the jumper to the appropriate pins, or remove it altogether (refer to the table and figure below).
2. Install the SIMMs as shown below.

Macintosh SE SIMM/Jumper Configurations

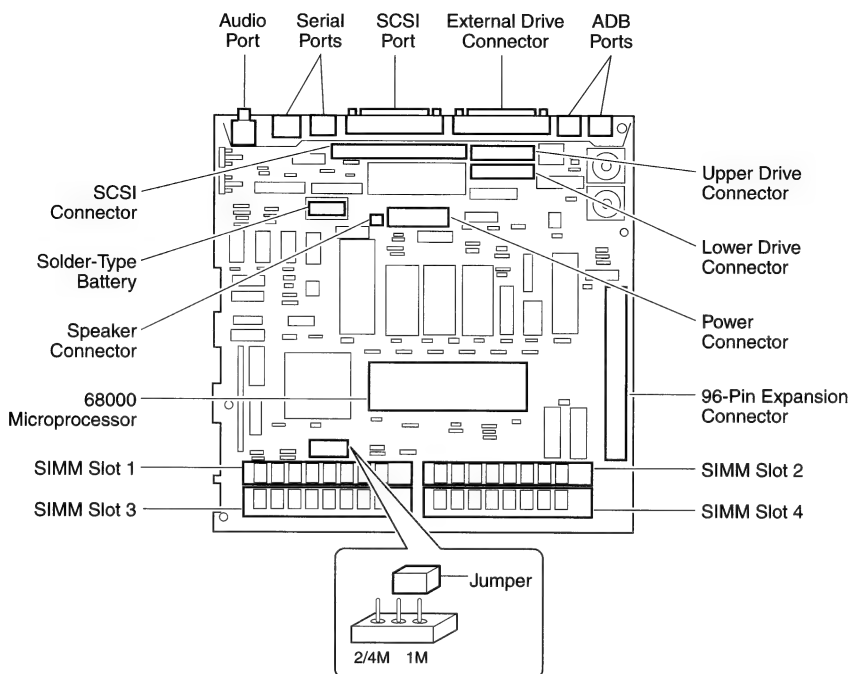| RAM	Jumpers	SIMMs
1 MB	2/4M 1M	Four 256K SIMMs
2 MB	2/4M 1M	Two 1 MB SIMMs (slots 3 & 4)
2.5 MB	2/4M 1M	Two 1 MB SIMMs (slots 3 & 4) Two 256K SIMMs (slots 1 & 2)
4 MB	2/4M 1M	Four 1 MB SIMMs

Figure 3   Macintosh SE Jumper-Type Logic Board

Memory Upgrade—Macintosh SE/30

The Macintosh SE/30 requires 120 ns (or faster) SIMMs. Using 150 ns SIMMs will cause serious timing problems. Oversized 256K and 1 MB DIP SIMMs should be installed in Bank A only. All SIMMs in each bank must be the same memory size.

Macintosh SE/30 Memory Configurations

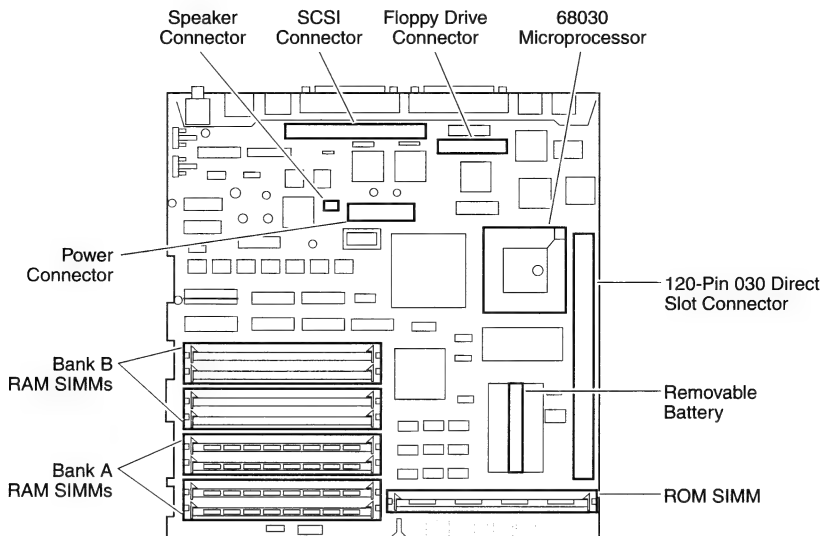| RAM	Resistors	SIMMs
2 MB	Four 256K SIMMs	Four 256K SIMMs
4 MB	Four 1 MB SIMMs	Empty
5 MB	Four 1 MB SIMMs	Four 256K SIMMs
8 MB	Four 1 MB SIMMs	Four 1 MB SIMMs

Figure 4   Macintosh SE/30 Logic Board

SuperDrive Upgrade—Macintosh SE

Note   You must use system software version 6.0.3 or higher if you want to use the Apple 1.4 MB SuperDrive in the Macintosh SE. If the software is lower than 6.0.2, the 1.4 MB drive will be recognized as an 800K mechanism.

1. Remove the cover and discharge the CRT.
2. Place the Macintosh SE on the grounded workbench pad and put on your grounding wriststrap.
3. Remove the video board, the hard drive or upper 800K drive, the logic board, and the lower 800K drive.
4. Using the IC extractor, remove the IWM chip at location D8 and the two ROM chips at locations D6 and D7 on the logic board.
5. Install the SWIM chip and the two new ROMs as indicated in the following chart. The notch at the end of the SWIM chip and each ROM should face the front of the logic board (toward the SIMMs).

ROM	P/N	Location
SWIM	344-0062	D8
HI	342-0701	D6
LO	342-0702	D7

6. Install the SuperDrive in the lower internal drive.
7. Replace the logic board; the hard drive, upper 800K drive, or second SuperDrive; the video board; and the cover.
8. Place the appropriate 1.4 MB and 800K labels in the grooves next to the upper and lower drive slots on the front bezel of the Macintosh SE.
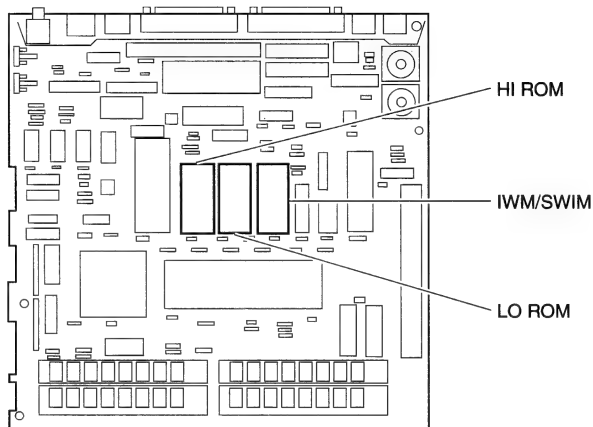

Figure 5   Macintosh SE Logic Board

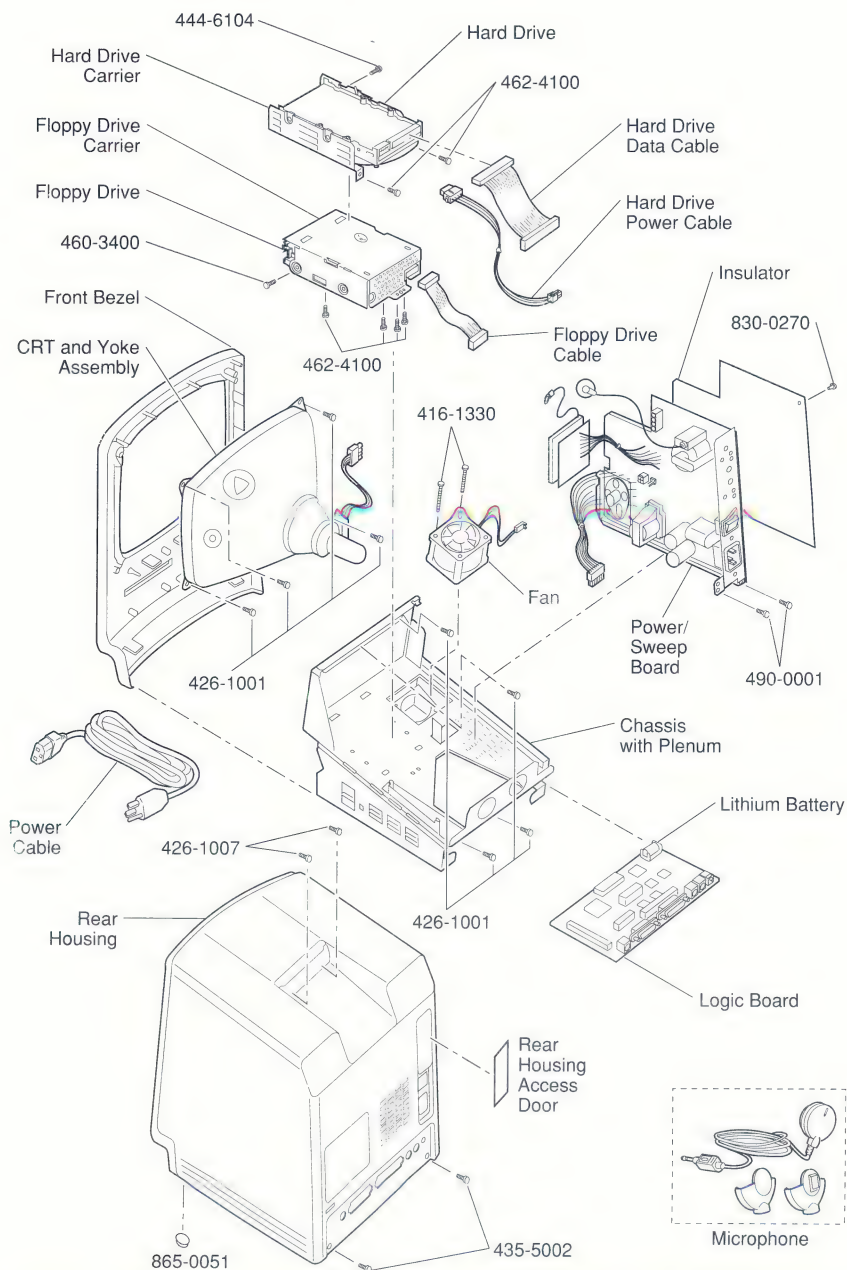# Macintosh Classic, Classic II, and Performa 200

Illustrated Parts List

Figure 1   Macintosh Classic, Classic II, and Performa 200 Exploded View

Macintosh Classic, Classic II, and Performa 200

Battery, lithium (w/o leads) 742-0011
Cable, AC power, 110 V (smoke) 590-0380
CRT and yoke assembly (rev B)...630-5954
Fan...982-0055
    Screw, M 3 x 0.5 x 30 mm (fan to plenum) 416-1330
Floppy drive, Apple 3.5", 1.4 MB SuperDrive 661-0474
Floppy drive accessories
    Cable, 3.5" internal drive (red or yellow stripe) 590-0188
    Cable, 3.5" internal drive (yellow stripe).....................................590-0437
    Cable, 1.4 MB SuperDrive, internal (red stripe) 590-0167
    Drive carrier, 800K or 1.4 MB 805-5050
    Packing disk, 2-sided (for transporting) 003-0003
    Screw, M 3 x 0.5 x 6 (drive carrier to drive) 460-3400
    Screw, M 3.5 x .6 x 8, PNCR Rec (drive carrier to chassis) 462-4100
    Service packaging, 800K and 1.4 MB drives 602-0210
HDA, 1" internal, 40 MB, 3.5" SCSI 661-0614
    Cable, HDA, internal (SCSI connector cable) 590-0211
    Cable, HDA, power 590-0521
    HDA carrier, internal 3.5" SCSI...805-0950
    Screw, 6 - 32 x 0.250 (HDA carrier to HDA) 444-6104
    Screw (HDA carrier to SuperDrive carrier).................................462-4100
    Service packaging, 3.5" HDA...602-0164
    Service pkg, 3.5" HDA, 1-inch-ht, w/o carrier..............................602-0308
Keyboard II, Apple*...661-0603
Mouse, ADB* 661-0479
Power/sweep board accessories
    Insulator, power/sweep board...815-1216
    Rivet, nylon snap-in, black...830-0270
    Screw (power/sweep to chassis) 490-0001
Rear housing accessories
    Foot, platinum 865-0051
    Rear housing access door 815-1195
    Screw, tap, 8-32 x .625, fill, Torx, black zinc oxide (case bottom)...435-5002
    Screw, tap, M 4.22 x 1.41 x 16, pan, Torx, zinc (case top).........426-1007
Screw, tap, M 4.22 x 1.41 x 13, Torx, zinc (chassis to bezel)..........426-1001
Screw, tap, M 4.22 x 1.41 x 13, pan, Torx, zinc (CRT to chassis) ..426-1001

Macintosh Classic only

Chassis with plenum..805-0985
CRT and yoke assembly (rev A)..076-0103
Front bezel..630-5825
Logic board, 1 MB...661-0596

Internal SCSI terminator 630-0408
Memory expansion board, 1 MB, (w/o SIMMs)................................661-0598
Power/sweep board 110 V (rev A)..661-0597
Power/sweep board 220 V (rev A)..661-0599
Rear housing assembly with feet...630-5812
      Audio adapter cable..590-0612
      Rear housing door 815-0986
      Reset/interrupt switch 815-1008
      Screw, tap, 8-32 x .625, fill, Torx, black zinc oxide (main case) .435-5002
      Screw, tap, M 4.22 x 1.41 x 16, pan, Torx, zinc (main case)......426-1007
      Upper ground clip...805-0575
SIMM, 256K, 120 ns 661-0402
SIMM, 1 MB, 120 ns 661-0403
SIMM, DIP, 256K, 120 ns 661-0494
SIMM, DIP, 1 MB, 120 ns 661-0410

Macintosh Classic II and Performa 200 only

Chassis with plenum..630-5818
Front bezel (Classic II)...630-6046
Front bezel (Performa 200)...922-0832
HDA, 1" internal, 80 MB, 3.5" SCSI 661-0624
Logic board, 2MB...661-0672
Microphone 699-5103
Power/sweep board, 110 V (rev B)...661-0651
Power/sweep board, 220 V (rev B)...661-0652
Rear housing assembly with feet...630-6045
SIMM, 1 MB, SOJ, 80 ns 661-0520
SIMM, 1 MB, SOJ, 80 ns 661-0719
SIMM, 2 MB, SOJ, 80 ns 661-0643

Specifications—Macintosh Classic

Processor	Motorola 68000 microprocessor 32-bit internal data bus 7.8336 MHz 256-byte instruction and data caches
Memory	RAM: 1 MB, expandable to 4 MB (120 ns or faster SIMMs) ROM: 512K PRAM: 256 bytes Cache connector: 44-pin connector for optional memory expansion; 256K by 4-bit DRAMs; includes two SIMM connectors for additional RAM expansion
Disk Storage	Floppy drive: Internal 1.4 MB floppy drive; optional external 800K or 1.4 MB floppy drive Hard drive: Optional internal 40 MB hard drive; optional external hard drives (max. of six)
I/O Interfaces	ADB: One ADB port; mini DIN-4 connector Serial: Two RS-422 serial ports; mini DIN-8 connectors Drive: External drive port, DB-19 connector SCSI: One SCSI parallel port; DB-25 connector Sound: Dual-channel headphone connector; connected to the monophonic sound output (does not provide true two-channel output, although stereo jack may be used)
I/O Devices	Keyboard: 80 keys, with numeric keypad; ADB connector Mouse: Mechanical tracking; ADB connector
Sound and Video	Video display: 9-in. (diagonal) screen; high-resolution, 512 by 342 pixel, bit-mapped monochrome display Sound generator: Four-voice sound with 8-bit digital/analog conversion, using 22-kHz sampling rate
Electrical	Line voltage: 100–120 VAC, 200–240 VAC (international only) Frequency: 47–63 Hz, single phase Maximum power: 100 W
Physical	Height: 13.2 in. (33.6 cm) Width: 9.7 in. (24.6 cm) Depth: 11.2 in. (28.5 cm) Weight: 16.7–17.1 lb. (7.3–7.8 kg) not including hard drive

Specifications—Macintosh Classic II and Performa 200

Processor	Motorola 68030 microprocessor 32-bit internal data bus 16 MHz 256-byte instruction and data cache Runs System 7.0.1 or later
Memory	RAM: 2 MB, expandable to 10 MB (100 ns or faster SIMMs); includes two SIMM connectors for adding RAM ROM: 512K PRAM: 256 bytes
Disk Storage	Floppy drive: Internal 1.4 MB floppy drive; optional external 800K or 1.4 MB floppy drive Hard drive: Internal 40 or 80 MB hard drive; optional external hard drive
I/O Interfaces	ADB: One ADB port; mini DIN-4 connector Serial: Two RS-422 serial ports; mini DIN-8 connectors Drive: External drive port; DB-19 connector SCSI: One SCSI parallel port; DB-25 connector Sound: Dual-channel headphone connector; connected to the monophonic sound output
I/O Devices	Keyboard: 80 keys, with numeric keypad; ADB connector Mouse: Mechanical tracking; ADB connector Microphone: Electret, omnidirectional; output voltage is 4 mV, peak-to-peak, at normal volume
Sound and Video	Video display: 9-in. (diagonal) screen; high-resolution, 512 by 342 pixel, bit-mapped monochrome display Sound generator: Monophonic 8-bit digital/analog conversion, using 22-kHz sampling rate capable of driving stereo headphones or other stereo equipment through the sound jack
Electrical	Line voltage: 100–120 VAC; 200–240 VAC (international only) Frequency: 47–63 Hz, single phase Maximum power: 100 W
Physical	Height: 13.2 in. (33.6 cm) Width: 9.7 in. (24.6 cm) Depth: 11.2 in. (28.5 cm) Weight: 16.7–17.1 lb. (7.3–7.8 kg) not including hard drive

Symptom/Cure Chart

Video Problems	Solutions
Screen dark; audio and drive operate	1. Readjust brightness.
	2. Readjust contrast.
	3. Check yoke cable connection.
	4. Replace power/sweep board.
	5. Replace logic board. Retain customer's SIMMs.
	6. Replace CRT.
Screen bright and audio present, but no video information visible	1. Replace power/sweep board.
	2. Replace logic board. Retain customer's SIMMs.
Screen dark and fan not running	– Replace power/sweep board.
Screen displays single vertical or horizontal line	1. Replace power/sweep board.
	2. Replace logic board. Retain customer's SIMMs.
	3. Replace CRT
Screen displays vertical/horizontal bars or stripes	1. Replace power/sweep board.
	2. Replace logic board. Retain customer's SIMMs.
Screen displays white dot in center of screen	1. Check yoke cable connection.
	2. Replace power/sweep board.
	3. Replace CRT.
Screen jitters	1. Move computer away from adjacent electrical equipment that may cause interference
	2. Replace power/sweep board.

Peripheral Problems	Solutions
Cursor doesn't move	1. Check mouse connection.
	2. If mouse was connected to keyboard, connect it to rear ADB port. If mouse now works, replace keyboard. If mouse does not work in any ADB port, replace mouse.
	3. Replace logic board. Retain customer's SIMMs.
Cursor moves, but clicking mouse button has no effect	1. Replace mouse.
	2. Replace logic board. Retain customer's SIMMs.
No response to any key on keyboard	1. Check keyboard connection to rear ADB port.
	2. Replace keyboard cable.
	3. Replace keyboard.
	4. Replace logic board. Retain customer's SIMMs.

Can't double-click to open application, disk, or server	1. Disable Extensions. Hold down \<Shift\> key and reboot. 2. Remove extra system files on hard drive. 3. Clear parameter RAM. System 7: Hold down \<Shift\> \<Option\> \<R\> \<P\> during startup but before "Welcome to Macintosh" appears. System 6 and earlier: Hold down \<Shift\> \<Option\> \<Command\> and select **Control Panel** from Apple menu. 4. If mouse was connected to keyboard, connect it to rear ADB port. If mouse works, replace keyboard. If mouse does not work in any ADB port, replace mouse. 5. Replace logic board. Retain customer's SIMMs.
Known-good ImageWriter or ImageWriter II doesn't print	1. Make sure Chooser and Control Panel are set correctly. 2. Replace printer driver and system software with known-good driver and system software. 3. Replace printer interface cable. 4. Replace logic board. Retain customer's SIMMs. 5. Replace power/sweep board.
Known-good LaserWriter doesn't print	1. Make sure Chooser and Control Panel are set correctly. 2. Replace printer driver and system software with known-good driver and system software. 3. Refer to Networks manual in *Service Source.*

Floppy Drive Problems	**Solutions**
Audio and video present, but internal floppy drive doesn't operate	1. Replace bad disk. 2. Replace floppy drive cable. 3. Replace floppy drive. 4. Replace logic board. Retain customer's SIMMs.
External floppy drive doesn't operate	1. Replace bad disk. 2. As you face computer screen, be sure external floppy drive is on right side of Macintosh. 3. Replace external floppy drive. 4. Replace logic board. Retain customer's SIMMs.
Drive doesn't eject disk	1. Push opened paper clip into hole beside drive to manually eject disk. 2. Switch off system power and hold mouse button down while switching power back on (to complete eject cycle). 3. Replace floppy drive.
Disk ejects; display shows icon with blinking "X"	1. Replace disk with known-good system disk. 2. Replace floppy drive. 3. Replace logic board. Retain customer's SIMMs.
Unable to insert disk all the way	1. To eject previously inserted disk, push opened paper clip into hole beside drive. 2. Switch off system power and hold mouse button down while switching power back on (to complete eject cycle). 3. Replace floppy drive.

Internal floppy drive runs continuously	1. Replace bad disk.
	2. Replace floppy drive cable.
	3. Replace floppy drive.
	4. Replace logic board. Retain customer's SIMMs.

Hard Drive Problems   Solutions

Internal or external hard drive doesn't operate	1. Verify that SCSI loopback card is not attached.
	2. Verify that all three internal hard drive terminators are on hard drive circuit board (internal hard drive systems only).
	3. Replace hard drive data cable.
	4. Replace hard drive.
	5. Replace logic board. Retain customer's SIMMs.

Works with internal or external SCSI device but not with both	1. Verify that SCSI device ID switch setting on external device is higher than 0. Verify that all ID switch settings on external SCSI devices are unique.
	2. Replace terminator on external SCSI device.
	3. Replace SCSI device select cable.

Misc. Problems   Solutions

Clicking, chirping, or thumping sound	1. Verify that logic board power cable is connected at J12 on logic board.
	2. Replace power/sweep board.
	3. Replace logic board. Retain customer's SIMMs.

No video, no audio, and no drive operation	1. Connect power cord and switch power on.
	2. Replace power cord.
	3. Replace power/sweep board.
	4. Replace logic board. Retain customer's SIMMs.

"Sad Macintosh" icon displays	1. Replace bad floppy disk.
	2. Verify that jumper on memory expansion board is configured correctly (see Macintosh Classic Memory Upgrade).
	3. On 4 MB Classic, confirm that SIMMs are 8-chip SIMMs. Refer to "SIMM Compatibility Chart" in General Information section.
	4. Macintosh Classic: Replace optional memory expansion board. Macintosh Classic II/Performa 200: Replace optional SIMMs in two SIMM slots on logic board.
	5. Replace logic board. Retain customer's SIMMs.

Screen displays "sad Macintosh" icon and black lines; screeching sound	1. Verify that jumper on memory expansion board is configured correctly (see Macintosh Classic Memory Upgrade).
	2. On 4 MB Classic, confirm that SIMMs are 8-chip SIMMs. Refer to "SIMM Compatibility Chart" in General Information section.
	3. Macintosh Classic: Replace optional memory expansion board. Macintosh Classic II/Performa 200: Replace optional SIMMs in two SIMM slots on logic board.
	4. Replace logic board. Retain customer's SIMMs.

| Smoke/odor | – Replace power/sweep board. |

Video Adjustments

Video adjustments may be necessary after you replace the CRT or the power/sweep board. All video adjustments (except the tilt adjustment) are made from the service panel at the back of the computer under the service panel door (see Figure 2).

Figure 2   Service Panel

▲ **Warning**   **Video adjustments are performed with the power on. Review the CRT safety rules before performing these procedures.**

You must use the Brightness and Video test patterns from *MacTest CL* (Macintosh Classic) or *MacTest Pro* (Macintosh Classic II/Performa 200) to adjust the computer correctly. Before performing the following adjustments, make sure the computer has been on for at least 30 minutes.

Brightness and Contrast Adjustment

1.   Turn the computer so that the back is toward you, and place a mirror in front of the CRT screen. Remove the service panel door.
2.   **Macintosh Classic**—Boot *MacTest CL* and select **Brightness** from the Adjustments menu.
     Macintosh Classic II/Performa 200—Boot *MacTest Pro* and select **Brightness** from the Options menu to bring up the first brightness screen.
3.   Set your light meter (Sekonic Multi-Lumi, model L-248) for the 10–18 range.

4. Using a plastic flat-blade tweaker, adjust contrast pot PL2 (see Figure 2) so the luminance at the center of the screen reads at the high end of the black area between 10 and 11 on the light meter.
5. Click the mouse button to go to the next brightness level.
6. Set the light meter for the 2–10 range. Using a plastic hex alignment tool, adjust brightness pot PL4 (see Figure 2) so the luminance at the center of the screen reads at the top end of 7 on the light meter.
7. Click the mouse button again to go to the next brightness level.
8. Reset the light meter for the 10–18 range and be sure the luminance at the center of the screen reads at the high end of the black area between 10 and 11 on the light meter. If it does not, repeat steps 2 through 8.

Centering Adjustment

1. **Macintosh Classic**—Select the all-white or crosshatch test pattern (with white background) from *MacTest CL*.
   Macintosh Classic II/Performa 200—To generate the needed test pattern, select **Screen Patterns** from the *MacTest Pro* main menu. Click to advance to the all-white or crosshatch pattern (with white background).
2. Using a plastic hex alignment tool, adjust horizontal centering pot PL3 to center the display horizontally within the bezel.
3. Using a plastic hex alignment tool, adjust vertical-centering pot PF2 to center the picture vertically within the bezel.

Size Adjustment

1. **Macintosh Classic**—Select the all-white or crosshatch test pattern (with white background) from *MacTest CL*
   Macintosh Classic II/Performa 200—To generate the needed test pattern, select **Screen Patterns** from the *MacTest Pro* main menu. Click to advance to the all-white or crosshatch pattern (with white background).
2. Using a plastic hex alignment tool, adjust horizontal size pot LL2 until the picture is approximately 7 inches wide.
3. Using a plastic hex alignment tool, adjust vertical size pot PF1 until the picture is approximately 4.7 inches high.

Focus Adjustment

1. Select the focus display (with % signs) pattern.
2. Using a plastic flat-blade tweaker, adjust focus pot PL1 for the best overall focus.

Tilt Adjustment

1. Remove the cover and discharge the CRT. Turn the computer so that the back is facing you, and place a mirror in front of the CRT screen.
2. Loosen the yoke clamp screw two or three turns (see Figure 3).
3. Connect the power cord and switch the power on.
4. Place one hand behind your back, and with your other hand grasp only the plastic spokes of the yoke collar (see Figure 3). Rotate the yoke collar until the top and bottom edges of the picture appear parallel with the top and bottom edges of the bezel. **(Do not move the magnets, which are preset by the manufacturer and should not be adjusted.)**
5. Switch the power off, unplug the computer, and discharge the CRT.
6. Hold the yoke collar in position and tighten the yoke clamp screw so that the yoke collar will not slip (see Figure 3). Don't overtighten.
7. Connect the power cord and switch the power on to verify that the adjustment is still correct.
8. Replace the cover.

Figure 3   CRT Adjustment Controls

Macintosh Classic Memory Upgrade

The Macintosh Classic logic board has 1 MB of soldered RAM. You can upgrade a 1 MB Macintosh Classic by adding a memory expansion board that contains an additional 1 MB of soldered DRAM plus two SIMM slots. You can further upgrade the system by adding two 256K or two 1MB SIMMs to the memory expansion board. The two SIMM slots must contain SIMMs of like memory capacity (two 256K SIMMS or two 1 MB SIMMS), or both slots must be empty. You must use 120 ns or faster SIMMs in the Macintosh Classic. (Refer to "SIMM Compatibility Chart" in the General Information section.)

Figure 4   Macintosh Classic Memory Expansion Board SIMMs

The memory expansion board connects at a right angle to the logic board and is supported by the side of the chassis. When SIMMs are installed, the jumper must be over the first and second pins from the outside edge; when no SIMMs are installed, the jumper must be over the second and third pins (Figure 4).

Macintosh Classic II and Performa 200 Memory Upgrade

The Macintosh Classic II/Performa 200 logic board has 2 MB of soldered RAM. You can increase the amount of memory to 4, 6, or 10 MB of RAM by installing additional SIMMs in the two SIMM slots on the logic board. You must fill both slots with SIMMs of like memory capacity (two 1 MB, two 2 MB, or two 4 MB SIMMs), or leave both slots empty. The Classic II/Performa 200 requires 100 ns (or faster) SIMMs. (Refer to "SIMM Compatibility Chart" in the General Information section.)

To install a SIMM, hold it by its edges with the contacts on the SIMM pointing down. Insert the SIMM at an angle (bottom forward) into the SIMM slot. Push back on the top corners of the SIMM. You will hear a click when the SIMM snaps into place.

Figure 5   Macintosh Classic II Logic Board and SIMMs

Macintosh Classic Upgrade Kit

Use the Macintosh Classic II upgrade kit to upgrade a Macintosh Classic to a Classic II. The upgrade kit includes:

- Classic II logic board
- Classic II rear housing
- Microphone
- Accessory kit

1. Remove the Macintosh Classic logic board and memory expansion board.
2. Remove all SIMMs from the memory expansion board and return them to the customer.
3. Install the Classic II logic board and rear housing provided in the upgrade kit. (The Classic II rear housing provides an opening for the sound input port.) Give the customer the microphone and accessory kit.

The Macintosh Classic II requires 100 ns or faster SIMMs. If you remove 100 ns or faster 1 MB SIMMs from the Classic memory expansion board, you can install these SIMMs on the Classic II logic board in the two SIMM slots. Note that either you must install two SIMMs of like capacity in the SIMM slots, or you must leave both slots empty. For more information, refer to Macintosh Classic II and Performa 200 Memory Upgrade.

Battery Replacement

Take the following precautions when you store, handle, or dispose of lithium batteries:

- Inspect the integrity of battery wrappers and store the batteries in the same packaging, or in a similar closed, heavy plastic bag.
- Store batteries in a designated, well-marked area with limited access.
- Do not allow battery leads or terminals to short-circuit.
- Do not dispose of batteries in a fire or incinerator. They may explode.
- Lithium is water reactive. Dispose of lithium batteries as hazardous waste:

  Place the dead battery in the air-tight wrapper and packaging that came with the replacement battery. Mark the package DEAD and return it to Apple. However, if the battery is physically damaged (for example, leaking), do not return it to Apple; dispose of the battery according to your local hazardous waste ordinances.

To replace a defective battery,

1. Remove the logic board.
2. Grasp the old battery and pull it from the battery holder (Figure 6).
3. Orient the new battery so that the end marked "+" matches the "+" on the logic board. Insert the battery into the battery holder. If the battery holder has a cover, replace the cover.
4. Return the old battery to Apple as directed above.

Battery

Figure 6   Battery Replacement

Macintosh Portable

Portable

Illustrated Parts List

Figure 1   Macintosh Portable Exploded View

Specifications

Processor	Motorola 68HC000; 16-bit CMOS microprocessor; 32-bit internal registers; 24-bit address bus; 16-bit data bus; 15.6672 MHz
Memory	RAM: 1 MB using thirty-two 32K by 8-bit static RAM chips; 100 ns access time; expandable with optional RAM expansion card (addressing supports up to 9 MB) ROM: 256K using 128K by 8-bit devices; 150 ns access time; addressing supports up to 4 MB PRAM: 128K bytes VRAM: 32K of static video display memory
Disk Storage	Floppy drive: Internal 1.4 MB floppy drive Hard drive: Internal 40 MB hard drive (optional on original Portable)
I/O Interfaces	Disk interface: Apple SWIM chip; MFM/GCR modes; supports Macintosh 800K Disk Drive, Apple 3.5" Drive, Apple SuperDrive, and Apple Hard Disk 20 Video-out port: Supports the connection of external video devices SCSI port: 7.5 MB/sec transfer rate; supports a maximum of eight devices (computer is always device 7; optional internal SCSI hard drive is device 0) ADB: Low-speed serial interface; supports optional low-power mouse
I/O Devices	Keyboard: ADB interface; US, British, French Canadian, Japanese, German, Spanish, French, Swedish, and Italian versions available Trackball: ADB interface Mouse: Low-power version of ADB mouse; opto-mechanical type; ADB interface Numeric keypad (optional): 18 keys; ADB interface; US, Pacific, and European versions available
Sound and Video	Video display: 10-in. (diagonal) screen; reflective, active matrix, liquid crystal, flat-panel display; 640 by 400 pixels; 75 dpi; .28 mm dot size; .33 mm dot pitch; 80% active area; variable tilt; contrast is software adjustable to one of 32 levels Sound generator: One or four-voice mono (one or two in stereo) with 4-bit digital/analog conversion, using 22-kHz sampling rate; filtered by two Sony sound chips
Electrical	Main battery: Sealed lead acid; 6.5 V; maximum of 10 hours Backup battery: 9 V transistor Power adapter: 85–270 VAC input voltage, RMS (100–240 nominal); 48–62 Hz (50/60 nominal); 7.0–7.6 V output voltage (7.5 nominal); 5 milliamps–2.0 A (1.5 nominal); versions available for US, Japan, United Kingdom, Australia, and Europe Battery recharger (optional): 7.5 VAC input voltage; 6.5 VDC output
Physical	Height: 11 in. (279.4 mm) Width: 15.25 in. (387.35 mm) Depth: 14.83 in. (365.25 mm) Weight (with battery): 13.75 lb. (6.25 kg) without hard drive; 15.75 lb. (7.16 kg) with hard drive

Introduction

Before trying other troubleshooting aids, determine whether the Portable is receiving enough power. Perform the battery troubleshooting procedure below.

If the procedure does not resolve the problem, continue troubleshooting by starting up the system and listening for the diagnostic error chords. The chords indicate major problems with the logic board or battery. To identify remaining problems, run *MacTest* (if the system will boot) or *AppleCAT* (if the system will not boot). *MacTest* and *AppleCAT* perform identical tests.

Note *MacTest Portable* does not run on Portables with pseudostatic RAM logic boards.

If the system doesn't function properly or boot after you run the tests, refer to the "Symptom/Cure Chart" later in this section. If the symptom is not listed or is not clearly defined, refer to "Troubleshooting Flowchart." This flowchart provides step-by-step procedures for troubleshooting the complete Portable system.

Battery Basics

Note The power adapter by itself cannot provide enough power to operate the Macintosh Portable if the battery is not adequately charged.

Figure 2   Resetting the Power Manager

1. Connect the power adapter and check the battery level. Even with the power adapter connected, the Portable battery must be more than 25% charged to operate properly.
2. Make sure the battery cover is completely closed. The Portable will not operate unless the battery cover is closed.
3. Press any key—you may merely have forgotten to wake the Portable up!
4. As a last resort, reset the power manager.
   - Unlock the interrupt and reset switches (see Figure 2).
   - Simultaneously press and hold the reset and interrupt switches, and then release both of them.
   - Again, wake up the Portable by pressing any key.

Troubleshooting Flowchart

```
        ┌──────────┐
        │  START   │
        └────┬─────┘
             │
    ┌────────▼────────┐
    │ Reset power     │
    │ manager.        │
    └────────┬────────┘
             │
 ┌───────────▼──────────────┐
 │ Turn on system without   │
 │ startup disk (press any  │
 │ key except <Caps Lock>). │
 └───────────┬──────────────┘
             │
```

Do startup tones sound? — No → Is any video displayed? — No → 1. Replace keyboard. 2. Replace keyboard cable. 3. Replace logic board.

Is any video displayed? — Yes → 1. Replace speaker. 2. Replace logic board. → Go to Start

Do startup tones sound? — Yes →

Is startup tone normal? — No → Replace logic board.

Is startup tone normal? — Yes →

Is gray pattern displayed? — No → 1. Verfiy that display cable is connected. 2. Replace LCD display. 3. Replace display cable. 4. Replace logic board.

Is gray pattern displayed? — Yes → 1

Troubleshooting Flowchart

```
                        ┌───┐
                        │ 1 │
                        └─┬─┘
                          │
                          ▼
                      ╱Is      ╲
                    ╱ disk icon  ╲    No    ┌──────────────────┐     ╭──────────────╮
                   ⟨ with question ⟩───────▶│ Replace logic board.│──▶│  Go to Start  │
                    ╲   mark    ╱           └──────────────────┘     ╰──────────────╯
                      ╲displayed?╱
                          │
                         Yes
                          │
                          ▼
              ┌─────────────────────┐
              │ Insert System Tools │
              │ in floppy drive.    │
              └──────────┬──────────┘
                         │
                         ▼
                    ╱ Does ╲      No       ╱  Do   ╲      No    ┌────────────────────────────┐
                  ⟨ desktop ⟩─────────────▶⟨you hear ⟩─────────▶│ 1. Replace keyboard.        │
                    ╲appear?╱              ╲sounds from╱        │ 2. Replace keyboard cable.  │
                        │                  ╲disk drive?╱        │ 3. Replace logic board.     │
                       Yes                      │               └────────────────────────────┘
                        │                      Yes
                        │                       │
                        │                       ▼
                        │          ┌──────────────────────────────┐
                        │          │ 1. Use known-good startup disk.│         ╭──────────────╮
                        │          │ 2. Replace disk drive.         │────────▶│  Go to Start  │
                        │          │ 3. Replace disk drive cable.   │         ╰──────────────╯
                        │          │ 4. Replace logic board.        │
                        │          └──────────────────────────────┘
                        ▼
                    ╱  Do    ╲     No     ┌──────────────────────────────┐
                  ⟨ trackball and⟩───────▶│ 1. Reset power manager.       │
                  ⟨button function⟩       │ 2. Replace trackball.         │
                    ╲ correctly? ╱        │ 3. Replace trackball cable.   │
                        │                 │ 4. Replace logic board.       │
                       Yes                └──────────────────────────────┘
                        │
                        ▼
                 ╭──────────────╮
                 │     END      │
                 ╰──────────────╯
```

Troubleshooting Flowchart

Symptom/Cure Chart

Power Problems	Solutions
Screen is blank; computer not responding	1. If computer is new, verify that plastic sheet has been removed from between battery and contacts. 2. Reset power manager. 3. Connect power adapter and try computer again in 3 or 4 minutes. 4. Try known-good, charged main battery. If computer now works, replace main battery. 5. Verify that keyboard cable is securely connected at both ends. 6. Replace keyboard. 7. Replace keyboard cable. 8. Replace logic board.
After main battery removal, some Control Panel settings are different	1. If battery cover was replaced when main battery was removed, power to computer was interrupted and different settings are normal. Restore contents of Control Panel. 2. Replace backup battery.
Power adapter is plugged in and connected, but battery DA doesn't indicate charger is connected	1. Verify that charger is connected properly. 2. Try different main battery. If battery now charges, replace main battery. 3. Replace power adapter. 4. Replace logic board.
A low-power warning displays soon after startup	1. Battery needs recharging. Attach power adapter. 2. Make sure peripherals being used display low-power icon. 3. Reduce use of floppy or hard disk, modem, sound, or other power-consuming devices, or connect power adapter.
Battery needs recharging after computer is unused for 4 or more days	– If System is 6.0.4 and AppleTalk® is active, using Shutdown command allows serial communications controller (SCC) to draw excess current. To prevent this, select **Sleep** from Special menu or deactivate AppleTalk using Chooser prior to shutdown. Install System 6.0.5 or later.

Video Problems	Solutions
Some pixels never come on (blacken); no pattern	– Maximum number of five permanently off pixels (voids) is considered acceptable. If display contains six or more voids, replace LCD display.
Some pixels are always black; no pattern	– If any pixel remains on constantly, replace LCD display.
A row of pixels never blackens	1. Replace LCD display. 2. Replace display cable. 3. Replace logic board.

Macintosh Portable

A row of pixels is always black (black streaks)	1. Replace LCD display. 2. Replace display cable. 3. Replace logic board.
No display, but computer appears to be operating correctly	1. Verify that display cable is securely connected. 2. Replace LCD display. 3. Replace display cable. 4. Replace logic board.
Display looks blurred	1. Adjust angle of display. 2. Adjust screen contrast setting using Control Panel.
Display is too dark (nonbacklit display)	1. Not enough light is available. Locate computer closer to direct light or move light source closer to computer. 2. Adjust screen contrast setting using Control Panel. 3. Replace LCD display. 4. Replace logic board.
Display is too light (nonbacklit display)	1. Adjust angle of display. 2. Adjust screen contrast setting using Control Panel. 3. Replace LCD display.
Backlight level can't be changed	– Verify that version 1.3 of Portable CDEV is present. Earlier versions do not support backlight feature. (To check version of CDEV, select file named Portable in System Folder and select **Get Info** from File menu.)
Backlight doesn't operate	1. Verify that version 1.3 of Portable CDEV is present. Earlier versions do not support backlight feature. (To check version of CDEV, select file named Portable in System Folder and select **Get Info** from File menu.) 2. Check inverter PCA connections. 3. Replace inverter PCA. 4. Replace LCD display. 5. Replace logic board.

Floppy Drive Problems	**Solutions**
Audio and video present, but internal drive doesn't operate	1. Try different floppy disk. 2. Replace floppy drive. 3. Replace floppy drive cable. 4. Replace logic board.
Disk ejects while booting; display shows Mac icon with blinking "X"	1. Try known-good system disk. 2. Replace floppy drive. 3. Replace floppy drive cable. 4. Replace logic board.

Disk initialization fails	1. Verify that Apple-certified media are being used.
	2. Try different disk.
	3. Replace floppy drive.
	4. Replace logic board.

Disk doesn't eject	1. Shut down computer, press and hold down trackball or mouse button, and switch on computer.
	2. Eject disk manually by pushing opened paper clip into bottom case hole located near floppy drive.
	3. Replace floppy drive.
	4. Replace floppy drive cable.
	5. Replace logic board.

Hard Drive Problems	**Solutions**
Internal hard drive doesn't operate	1. Verify that external SCSI devices are switched on and hard drive cable is securely connected.
	2. Use *HD SC Setup* to see if drive is visible. If it is, reinitialize drive.
	3. Replace hard drive.
	4. Replace logic board.

Peripheral Problems	**Solutions**
After you connect external SCSI device, computer no longer boots	1. Turn on external SCSI device before starting up computer.
	2. Verify that proper cable termination is provided.
	3. Verify that no two SCSI devices have same device address.
	4. Replace logic board.

Cursor doesn't move when you use trackball	1. Reset power manager.
	2. Check cable connections between trackball and logic board.
	3. Replace trackball cable.
	4. Replace trackball.
	5. Replace logic board.

Cursor doesn't move when you use mouse	1. Check mouse connection to ADB port.
	2. Reset power manager.
	3. Clean mouse ball and inside mouse case
	4. Replace mouse.
	5. Replace logic board.

| Cursor intermittently doesn't move or moves erratically | 1. Clean trackball ball and internal rollers. |
| | 2. Replace trackball. |

Device connected to modem port doesn't work	1. Verify that **External Modem** is selected in Portable CDEV.
	2. If using System 6.0.4, upgrade to 6.0.5 or later.
	3. Replace logic board.

Cursor moves, but clicking button has no effect	1. If trackball button is not working, replace trackball cable. If mouse button is not working, replace mouse.
	2. Replace trackball.
	3. Replace logic board.
No response to any key on keyboard	1. If screen is blank and you are trying to bring computer out of system sleep, try resetting power manager.
	2. Check keyboard connection to logic board.
	3. Replace keyboard.
	4. Replace logic board.
Known-good ImageWriter, ImageWriter II, or ImageWriter LQ doesn't print	1. Make sure System 6.0.5 or later is being used.
	2. Make sure Chooser is set correctly.
	3. Replace printer cable.
	4. Replace logic board.
Known-good LaserWriter doesn't print	1. Make sure System 6.0.5 or later is being used.
	2. Make sure Chooser is set correctly.
	3. Try another printer. If that printer works, computer is OK. Refer to Networks section in *Service Source* or to *LaserWriter Printers Service Guide*.
	4. Replace logic board.
Serial devices are unrecognized or garbage is transmitted and/or received	1. If System 6.0.4 is being used, be sure Macintosh Portable INIT 1.0 is installed in System Folder.
	2. Upgrade to System 6.0.5 or later.
When using external modem: After exiting communication program and putting Portable to sleep three or four times, computer locks up when coming out of system sleep	– If System 6.0.4 is being used, upgrade to System 6.0.5 or later.

Internal Modem Problems   **Solutions**

Internal modem options don't appear in Portable CDEV when modem is installed	1. Try removing and reseating card.
	2. Replace modem card.
	3. Replace logic board.
Modem interferes with system sound	1. Replace modem card.
	2. Replace logic board.

Modem doesn't respond properly to AT command set instructions	1. Check baud rate and data format settings to ensure compatibility with Portable Data Modem 2400 and remote modem. 2. Replace modem card.
Modem doesn't respond to incoming call	1. If system does not respond to incoming call during sleep mode, verify that When Phone Rings option in Automatic Wake-Up section of Portable CDEV is selected. 2. Replace modem card. 3. Replace logic board.
Modem has no sound output	– Replace modem card.

Miscellaneous Problems	**Solutions**
Screen goes blank and computer shuts down every few minutes	– Computer is going into system sleep to conserve battery power. Adjust sleep delays in Control Panel or connect power adapter.
Some applications seem to run slower after running for a few seconds	– Computer is switching to system rest. To disable system rest, open Control Panel, hold down <Option> key, and click **Minutes Until Automatic Sleep**. When dialog box appears, click **Don't Rest**.
Hard drive is slow to respond or screen goes blank too often	– The computer is powering down hard drive or going into system sleep to conserve battery power. Adjust sleep delays in Control Panel or connect power adapter.
No sound from speaker	1. Verify that volume setting in Control Panel is 1 or above. 2. Check speaker connection to logic board. 3. Replace speaker. 4. Replace logic board.
Screen suddenly goes blank	– Computer has gone into system sleep to conserve battery power.

Installation Procedure

1. Place the Macintosh Portable on a grounded workstation mat and put on your grounding wriststrap.
2. Unplug the power adapter, and remove the rear cover and main battery.
3. Replace the main battery cover.

▲ **Caution**   **The 1 MB static RAM and the 1 MB and 3 MB pseudostatic RAM expansion cards *are not interchangeable*. Never install a static RAM card (unkeyed) on a pseudostatic logic board (keyed connector).**

4. Locate the RAM expansion connector (Figure 3-D). If the connector is not keyed, you must install a static RAM expansion card (Figures 3-A). If the connector is keyed, you must install a pseudostatic RAM expansion card (Figures 3-B and 3-C).
5. Position the static (not keyed) or pseudostatic (keyed) expansion card over the connector and plug in the card (see Figure 3-D).
6. Remove the battery cover and replace the main battery.
7. Replace the battery cover and the rear cover.

A   1 MB Static RAM
B   1 MB Pseudostatic RAM
C   3 MB Pseudostatic RAM
D

Figure 3   Static or Pseudostatic RAM Cards

Troubleshooting the Memory Upgrade

1. Turn on the computer by pressing any key except <Caps Lock>.

2. Pull down the Apple menu and select **About the Finder**.

3. Check that the amount of RAM indicated is 2048K (1 MB card) or 4096K (3 MB card). If the amount of RAM is not correct:
    *   Check that the correct card (static or pseudostatic) is installed.
    *   If the card is correct but the amount of RAM is not, replace the card.
    *   If the amount of RAM indicated is still not correct, replace the logic board.

Installation and Verification Procedure

The following procedure covers the installation and verification of the internal, Macintosh Portable Data Modem 2400 and the International XP 2400.

1. Unplug the power adapter, and remove the rear cover and main battery.
2. Remove the modem cap by pushing it through the rear of the computer.
3. Install the modem card in the modem connector. Make sure the modem card is on the right side of the modem gasket.
4. Replace the main battery, battery cover, and rear cover, and turn on the computer.
5. Use *ModemTest* to verify that the computer and modem are communicating, and use AppleLink® to verify operation of the modem with the telephone network.

Figure 4   Modem Installation Control Panel

The logic board for the original Macintosh Portable (with static RAM) and the logic board for the new Portable (with pseudostatic RAM) are not interchangeable. The pseudostatic logic board has eight soldered RAM chips; the logic board with static RAM has thirty-two soldered chips.

Logic Board Diagrams

Figure 5   Logic Board Components

Figure 6   Internal Connectors and Switches

Macintosh
PowerBook
Computers

Macintosh
PowerBook 100

Figure 1 Macintosh PowerBook 100 Exploded View

Shield

Interconnect Board

Inverter Board

Display Bezel

Brightness/Contrast Board

Brightness/Contrast Knob

Keyboard

Display

Brightness/ Contrast Cable

Top Cover

Power Adapter

Interconnect Cable and Speaker Assembly

Palm Rest Assembly

Phone Cable

Daughterboard

External Floppy Drive

Modem Shield

Modem

Modem Connector Cover

Trackball Assembly

Rear Connector Panel Cover

Main Battery

Memory Expansion Card

Backup Battery Door

Main Battery Door

Elevation Foot Assembly

Hard Drive Flex Cable

Motherboard

Screw Kit

Hard Drive

Bottom Housing Assembly

Screw Cover

Rubber Foot

Hard Drive Mounting Bracket

Specifications

Processor	Motorola 68000, 16 MHz microprocessor Addressing: 32-bit internal registers; 24-bit address bus; and 16-bit data bus
Memory	RAM: 2 MB of 100 ns pseudostatic RAM, expandable to 8 MB ROM: 256K (two 128 by 8-bit devices); 150 ns access time; addressing supports up to 4 MB PRAM: 128 bytes of system parameter memory VRAM: 32K of pseudostatic video display memory Clock/calendar: Custom chip with long-life lithium battery
Disk Storage	Floppy drive (optional): External Macintosh HDI-20 1.4 MB drive; 4.5 W startup power; 1.25 W random operation; 50 mW idle 20 MB hard drive: Apple SCSI interface; 2.5 in. mechanism; 23 msec average access time (max.); 5 W startup power; 2.7 W random operation 40 MB hard drive: Apple SCSI interface; 2.5 in. mechanism; <19 msec average access time (max.); 5 W startup power; 2.25–2.5 W random operation; 1.3–1.5 W idle
I/O Interfaces	Serial: Two RS-422 serial ports, one external and one internal; 230.4 Kbaud minimum; asynchronous, synchronous, and AppleTalk protocols supported; internal connector supports Macintosh PowerBook Fax/Data modem ADB: One ADB port; low-speed serial interface SCSI: HDI-30 SCSI port with 7.5 MB/sec. transfer rate; supports max. of five devices (computer is device 3; SCSI hard drive is device 0) Sound: One sound-output port for external audio amplifier Floppy drive: HDI-20 floppy drive port for external 1.4 MB drive
I/O Devices	Keyboard: Built-in, ADB interface keyboard Trackball: Dual-button trackball; 25 mm diameter; ADB interface Mouse (optional): Low-power, ADB interface mouse Floppy drive (optional): External Macintosh HDI-20, 1.4 MB floppy drive
Sound and Video	Video display: 9-in. (22.9 cm) diagonal screen; flat panel, film-compensated supertwist nematic (FSTN) backlit display; 640 by 400 pixels; 75 dpi Sound: Apple Sound Chip; one- or four-voice mono (one or two voices in stereo) with 4-bit digital to analog conversion using 22 KHz sampling rate

Electrical	Line voltage: 110–220 V
	Frequency: 50–60 Hz
	Power adapter: 85–270 VAC input voltage (100/240 nominal);
	    48–62 Hz (50/60 nominal); 7.0–7.6 V output voltage (7.5
	    nominal); 5 mA–2 A (1.5 nominal)
	ADB power requirements: Maximum current draw for all ADB
	    devices is 50 mA (max. of three devices recommended)
	Main battery: Sealed lead acid battery (7 V); 2.5 hr. capacity
	Backup batteries: Three 3.5 V lithium cells; industry standard
	    CR-4230 batteries

Physical	Height: 1.8 in. (4.6 cm) Width: 11 in. (28 cm) Depth: 8.5 in. (22 cm) Weight: 5.1 lb. (2.3 kg)

Troubleshooting—Introduction

Before You Start

- Check the battery and power adapter. The parameter RAM battery does not support system RAM. Save RAM contents before removing the main battery.
- Check connections on internal and external cabling and on option cards.
- Use System 7.0.1 or later.
- Remove all option cards and disconnect external devices (printers, SCSI devices, additional ADB devices, and disk drives).
- Test the internal cables with a known-good system.

Things to Remember

- When running the *Hard Disk Test* diagnostic to test the hard disk, operate the computer from the power adapter and do not select looping.
- Follow all electrostatic discharge precautions when working on the PowerBook 100. The computer is very sensitive to ESD.
- When you attach the power adapter to the computer but do not plug the computer into a power source, a low-power dialog box appears.
- The battery desk accessory is a general indicator of the battery charge level. Use a voltmeter to determine the actual charge.
- PowerBook computers do not provide termination power. Terminate SCSI devices following these guidelines:
  - If the computer has only one external SCSI device, add one terminator to that device.
  - If the computer has more than one external SCSI device, add one terminator to the first device and another terminator to the last device.

Battery Verification

Note   Save RAM contents before removing the main battery. Otherwise, RAM contents will be lost.

1. Disconnect the power adapter.

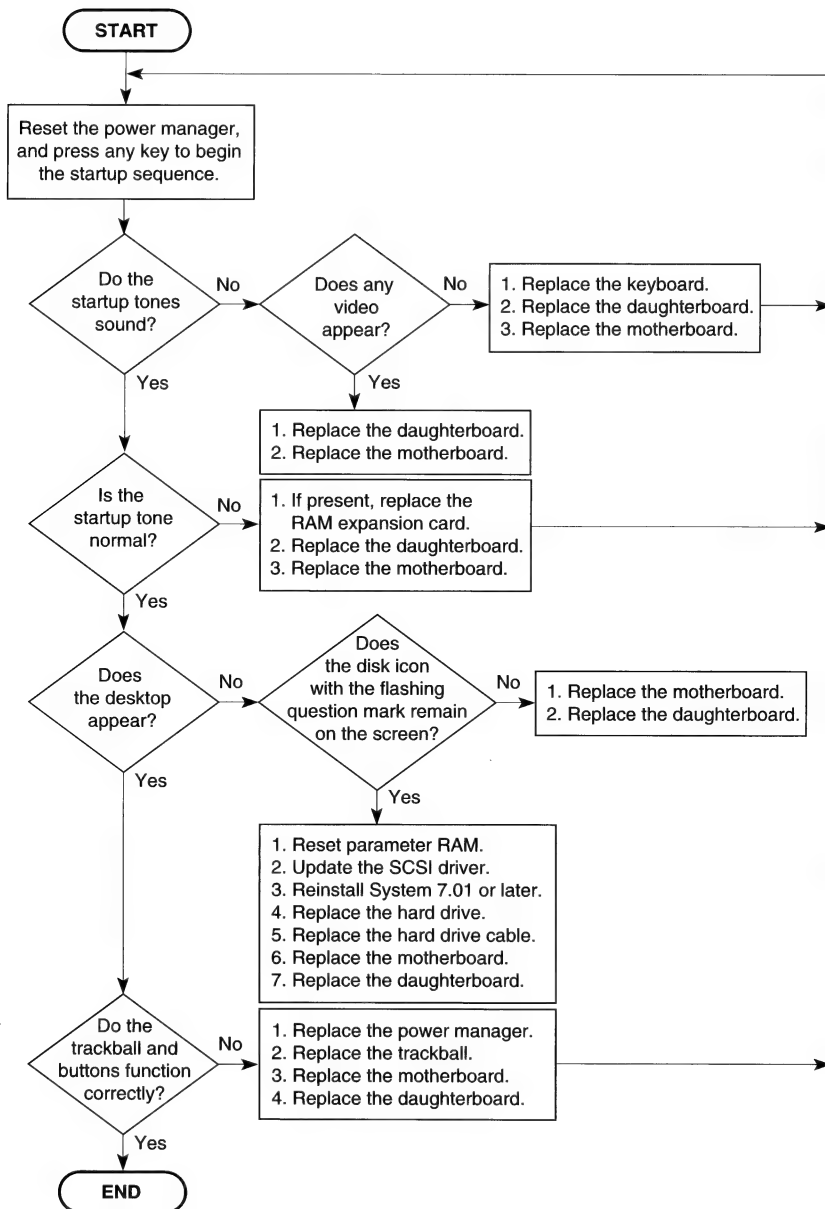**▲ Warning**   **Do not short the battery. The battery may become hot enough to burn you.**

2. Remove the main battery.
3. Set the voltmeter range to 10 volts DC.
4. Hold the positive probe of the voltmeter to the positive side of the battery and hold the negative probe to the negative side of the battery.
5. If the battery falls below 5.7 volts, recharge the battery. If the battery will not recharge, replace it.

Adapter Verification

1. Plug the power adapter into the wall source.
2. Set the voltmeter range to 10 volts DC.
3. Hold the positive probe of the voltmeter to the inside of the adapter plug and hold the negative probe to the outside of the adapter plug.
4. If the voltage is not between 7.5 and 7.9 volts, replace the adapter.

Caution   **You cannot use a Macintosh Portable power adapter on a PowerBook computer, or vice versa. You will damage the computer if you try to use the power adapters interchangeably.**

Troubleshooting Flowchart

```
                    ┌─────────────┐
                    │    START    │
                    └──────┬──────┘
                           │
                           ▼
          ┌───────────────────────────┐
          │ Reset the power manager,  │
          │ and press any key to begin│
          │  the startup sequence.    │
          └─────────────┬─────────────┘
                        │
                        ▼
```

Do the startup tones sound? — No → **Does any video appear?** — No → 1. Replace the keyboard. 2. Replace the daughterboard. 3. Replace the motherboard.

Yes (Does any video appear?) ↓

1. Replace the daughterboard.
2. Replace the motherboard.

Do the startup tones sound? Yes ↓

Is the startup tone normal? — No → 1. If present, replace the RAM expansion card. 2. Replace the daughterboard. 3. Replace the motherboard.

Is the startup tone normal? Yes ↓

Does the desktop appear? — No → **Does the disk icon with the flashing question mark remain on the screen?** — No → 1. Replace the motherboard. 2. Replace the daughterboard.

Does the disk icon with the flashing question mark remain on the screen? Yes ↓

1. Reset parameter RAM.
2. Update the SCSI driver.
3. Reinstall System 7.01 or later.
4. Replace the hard drive.
5. Replace the hard drive cable.
6. Replace the motherboard.
7. Replace the daughterboard.

Does the desktop appear? Yes ↓

Do the trackball and buttons function correctly? — No → 1. Replace the power manager. 2. Replace the trackball. 3. Replace the motherboard. 4. Replace the daughterboard.

Do the trackball and buttons function correctly? Yes ↓

```
                    ┌─────────────┐
                    │     END     │
                    └─────────────┘
```

Symptom/Cure Chart

Power Problems	Solutions
Screen is blank; computer doesn't respond	1. Verify that storage switch is in the on position.
	2. Reset computer.
	3. Connect AC adapter and restart computer in 3 to 4 minutes.
	4. Install known-good, charged main battery. If computer now works, replace main battery.
	5. Verify that keyboard cable is connected securely.
	6. Replace keyboard.
	7. Replace daughterboard.
	8. Replace motherboard.
After you change main battery, some Control Panel settings are different	– Replace backup batteries.
After you remove all power sources, some Control Panel settings are different	– This condition is normal. If you disconnect AC adapter and remove main and backup batteries, you remove all power to computer. Removing all power affects some Control Panel settings (such as time) in parameter RAM.
AC adapter is plugged in and connected, but battery DA doesn't indicate charger is connected	1. Verify that AC adapter is connected properly.
	2. Try known-good main battery. If battery now charges, replace main battery.
	3. Verify adapter is good.
	4. Replace AC adapter.
	5. Replace motherboard.
Low-power warning appears soon after computer starts	1. Battery needs recharging. Attach power adapter.
	2. Make sure peripherals display low-power icon.
	3. Extensive use of floppy or hard drives, modem, sound, backlight, or other power-consuming devices can produce low-power warning. Reduce use of these devices or connect AC adapter.

Video Problems	Solutions
Screen suddenly goes blank	– Computer has gone into system sleep to conserve battery power.
Screen goes blank and computer shuts down every few minutes	– Computer is going into system sleep to conserve battery power. If computer is going into system sleep too often, adjust sleep delays in Control Panel or connect AC adapter.
Pixel never comes on	– If more than five pixels do not come on, replace display.
Pixel is always switched on	– Replace display.

Row of pixels never comes on	1. Replace interconnect cable.
	2. Replace display.
	3. Replace interconnect board.
	4. Replace daughterboard.
	5. Replace motherboard.
	6. Return computer to Apple.
Partial or entire row of pixels is always on	1. Replace interconnect cable
	2. Replace display.
	3. Replace interconnect board.
	4. Replace daughterboard.
	5. Replace motherboard.
	6. Return computer to Apple.
Very slight white line is always in middle of screen	— This is normal for PowerBook 100 FSTN screen.
Display is very light or all white	1. Adjust screen contrast and brightness settings.
	2. Check interconnect cable connection to motherboard.
	3. Replace inverter board.
	4. Replace interconnect cable.
	5. Replace interconnect board.
	6. Replace display.
	7. Replace daughterboard.
	8. Replace motherboard.
	9. Return computer to Apple.
No display, but computer appears to operate correctly	1. Adjust screen contrast and brightness settings.
	2. Check interconnect cable connection to motherboard.
	3. Replace inverter board.
	4. Replace interconnect cable.
	5. Replace interconnect board.
	6. Replace display.
	7. Replace daughterboard.
	8. Replace motherboard.
	9. Return computer to Apple.
Display shows rainbow colors from extreme viewing angles	— This effect is normal for PowerBook 100 FSTN screen.
Image is not uniform	— This effect is normal for PowerBook 100 FSTN screen.
Display stopped working (or dimmed) but shows no problems now	— If temperature or light was extreme during problem time (under 5° C or over 45° C), operation is normal for PowerBook 100 FSTN screen.

Backlight doesn't
operate

1. Adjust screen brightness setting.
2. Check interconnect cable connection to motherboard.
3. Replace inverter board.
4. Replace interconnect cable.
5. Replace interconnect board.
6. Replace display.
7. Replace daughterboard.
8. Replace motherboard.
9. Return computer to Apple.

Peripheral Problems   **Solutions**

After you connect
external SCSI
device, computer
no longer boots

1. Switch on external SCSI device before starting computer.
2. Verify that Apple HDI-30 SCSI system cable is connected to computer and external SCSI device(s).
3. Verify that cable termination is correct.
4. Verify that no SCSI devices have same device address.
5. Replace daughterboard.
6. Replace motherboard.

Cursor doesn't move
when you move
trackball

1. Reset computer.
2. Check cable connection between trackball and motherboard.
3. Replace trackball assembly.
4. Replace motherboard.

Cursor intermittently
doesn't move or
moves erratically

1. Clean trackball ball and internal rollers.
2. Replace trackball assembly.

Cursor doesn't
move when you
move mouse

1. Check mouse connection to ADB port.
2. Reset computer.
3. Clean mouse ball and inside of mouse.
4. Replace mouse.
5. Replace motherboard.
6. Replace daughterboard.

Cursor moves, but
clicking button has
no effect

1. Check cable connection between trackball and motherboard.
2. Replace trackball assembly.
3. Replace daughterboard.
4. Replace motherboard.

No response to any
key on keyboard

1. Reset computer.
2. Connect AC adapter and restart computer in 3 to 4 minutes.
3. Install known-good, charged main battery. If computer now works, replace main battery.
4. Verify that keyboard cable is securely connected to motherboard.
5. Replace keyboard.
6. Replace daughterboard.
7. Replace motherboard.

Known-good ImageWriter, ImageWriter II, or LQ doesn't print	1. Make sure System is 7.0.1 or later. 2. Make sure Chooser is set correctly. 3. Verify that printer cable is attached securely. 4. Replace printer cable. 5. Replace motherboard. 6. Replace daughterboard.
Known-good LaserWriter doesn't print	1. Make sure System is 7.0.1 or later. 2. Make sure Chooser setting is correct. 3. Verify that all printer cabling is attached securely. 4. Try another printer. If that printer works, computer is OK. Refer to Networks manual on *Service Source.* 5. Replace motherboard. 6. Replace daughterboard.
Serial devices are unrecognized or garbage is transmitted and/or received	1. Make sure System is 7.0.1 or later. 2. Verify that cabling is correct type and securely attached. 3. Attach device(s) in chain to known-good computer. 4. Replace motherboard. 5. Replace daughterboard.

Hard Drive Problems **Solutions**

Internal hard drive doesn't operate	1. Verify that all external SCSI devices are switched on. 2. Verify that internal hard drive flex cable is connected securely at both ends. 3. Use *HD SC Setup* (which is supplied with system software) to see whether drive is visible to program. If drive is visible, update SCSI driver. 4. Reinstall system software. 5. Replace hard drive flex cable that connects hard drive to motherboard. 6. Replace hard drive. 7. Replace motherboard. 8. Replace daughterboard.
Hard drive is slow to respond, or screen goes blank too often	– Computer powers down the hard drive or goes into system sleep to conserve battery power. Adjust sleep delays in Control Panel or connect AC adapter.

Internal Modem Problems **Solutions**

Internal modem options don't appear in Control Panel window, but modem is installed	1. Reseat modem card. 2. Replace modem card. 3. Replace motherboard. 4. Replace daughterboard.
Modem interferes with system sound	1. Replace modem card. 2. Return computer to Apple.

Modem has no sound output	1.	Replace modem card.
	2.	Replace motherboard.
	3.	Replace daughterboard.
Strange mix of characters appears on screen	1.	Verify that baud rate and data format settings of communications application are compatible with internal modem and remote modem.
	2.	Verify telephone cord is attached securely and working properly.
	3.	Replace modem card.
Modem doesn't respond properly to AT command set instructions	1.	Verify that baud and data format settings of communications application are compatible with internal modem and remote modem.
	2.	Verify that telephone cord is attached securely and working properly.
	3.	Verify that phone line produces dial tone.
	4.	Replace modem card.
Modem doesn't respond to incoming call	1.	If system doesn't respond during sleep mode, verify that Wake on Ring option in CDEV is selected.
	2.	Verify that telephone cord is attached securely and working properly.
	3.	Replace modem card.
	4.	Replace motherboard.
	5.	Replace daughterboard.
Modem connects but doesn't communicate with remote modem	—	Verify that remote modem needs error correction. If remote modem does not need error correction, disable error correction by typing **&Q0** (see *Macintosh PowerBook Fax/Data Modem User's Guide*).

Miscellaneous Problems	**Solutions**	
Some applications seem to run slower after a few seconds	—	Computer is switching to system rest. If system rest is interfering with operation of application, connect AC adapter.
No sound from speaker	1.	Set volume (in Control Panel) to 1 or above.
	2.	Check speaker connection to motherboard.
	3.	Replace motherboard.
Error chord sounds during startup sequence	1.	Connect AC adapter and restart computer in 3 to 4 minutes.
	2.	Replace memory expansion board (if installed).
	3.	Replace motherboard.
	4.	Replace daughterboard.

1. Disconnect the AC adapter and remove the backup batteries, main battery, display assembly, and keyboard.
2. Push the metal prongs (Figure 3) toward the back of the computer until you can lift the modem shield up and out of the bottom cover.
3. Lift the modem connector cover out of the bottom cover.
4. Position the fax/data modem so that connector J1 on the modem faces down and directly above connector J9 on the motherboard. Verify that the holes in the modem align with the plastic standoffs on the motherboard. Press down on the modem until the board locks in place on the plastic standoffs.
5. Replace the modem shield. The tabs that mount over the metal prongs belong between the metal prongs and the rear wall of the main battery cavity. The modem shield should not extend into the main battery cavity.
6. Replace the keyboard, display assembly, main battery, and backup batteries.
7. Apply the FCC and DOC labels to the left of the modem connector.

Figure 3   Internal Modem Installation

Note   To remove the fax/data modem, use needlenose pliers to release the locking tabs of the two standoffs and lift the modem from the motherboard.
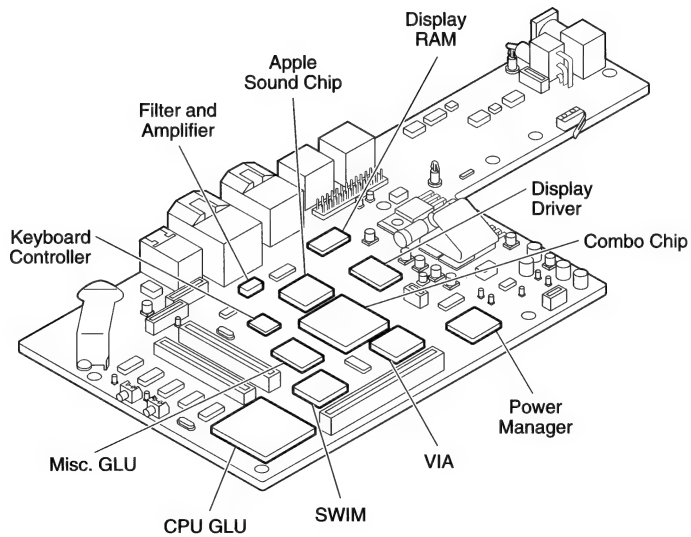
Motherboard and Daughterboard Diagrams

Display
RAM

Apple
Sound Chip

Filter and
Amplifier

Keyboard
Controller

Display
Driver

Combo Chip

Misc. GLU

VIA

Power
Manager

CPU GLU

SWIM

Figure 4   Macintosh PowerBook 100 Motherboard

RAM

CPU

ROM

Figure 5   Macintosh PowerBook 100 Daughterboard

Macintosh
PowerBook 140,
145, 160, 170,
and 180

Display Housing

Display

Display Bezel

EMI Shield

Rubber Plug

PowerBook 140/145/160 Display Cable

Inverter Cable

Brightness Actuator

PowerBook 170/180 Display Cable

Elevation Foot

End Clutch Cover

Battery Recharger

Clutch Assembly

Trackball Assembly

Center Clutch Cover

Drive Retainer

I/O Door

Floppy Drive

Interconnect Board

Inverter Board

Hard Drive

Keyboard

Modem

Modem Port Cover

Floppy Drive Cable

RAM Card

Hard Drive Cable

Motherboard

Case Bottom

Daughterboard

Foot

Power Adapter

Battery Door

Main Battery

Figure 1   Macintosh PowerBook 140/145/160/170/180 Exploded View

Specifications—Macintosh PowerBook 140, 145, and 170

Configuration	PowerBook 140: 2 MB RAM; FSTN display; 20/40/80 MB hard drive; 1.4 MB floppy drive; NiCad battery; AC adapter; microphone PowerBook 145: 4 MB RAM; FSTN display; 40/80 MB hard drive; 1.4 MB floppy drive; NiCad battery; AC adapter; microphone PowerBook 170: 4 MB RAM; math coprocessor; active-matrix display; 40/80 MB hard drive; 1.4 MB floppy drive; NiCad battery; AC adapter; fax/data modem; microphone Options: Macintosh PowerBook Fax/Data Modem (standard on 170); memory expansion kits; PowerBook battery recharger; HDI-30 SCSI system cable
Processor	Motorola 68030 microprocessor; 16 MHz on 140; 25 MHz on 145 and 170 Coprocessor (PowerBook 170 only): Motorola 68882 floating-point unit; 25 MHz Addressing: 32-bit internal registers, address bus, and data bus
Memory	RAM: 4 MB, expandable to 8 MB ROM: 1 MB PRAM: 256 bytes VRAM: 256K of static video display memory Clock/calendar: Custom chip with long-life lithium battery
Disk Storage	Floppy drive: 19-mm high, 1.4 MB Apple SuperDrive Hard drive: 2.5-in. hard drive (many capacities)
I/O Interfaces	ADB: ADB port (max. of three ADB devices); 200 mA max. current draw for all ADB devices Serial: Two RS-422 serial ports; mini DIN-8 connectors SCSI: HDI-30 SCSI port with 1.5 MB/sec. transfer rate; supports max. of five external SCSI devices; does not provide termination power; connection to another computer requires HDI-30 SCSI system cable Floppy drive: DB-19 port for connecting external floppy drives Sound: Monaural sound-in port; stereo sound-out headphone jack that plays CD audio tracks in stereo and computer-generated sounds in mono Power adapter: Power adapter port Modem: Slot for optional modem (standard on PowerBook 170)
I/O Devices	Keyboard: Built-in keyboard with standard Macintosh layout; 63 keys domestic, 64 keys ISO; two-level tilt adjustment Trackball: 30 mm diameter, dual button; ADB interface Microphone: Electret, omnidirectional; output voltage of 4 mV, peak-to-peak

Sound and Video	Video display (PowerBook 140 and 145): 10-in. (25.4 cm) diagonal screen; flat-panel, film-compensated supertwist nematic (FSTN) liquid crystal display; CCFL on-demand backlight; 640 by 400 pixels Video display (PowerBook 170): 10-in. (25.4 cm) diagonal screen; flat-panel, active matrix, liquid crystal display; CCFL on-demand backlight; 640 by 400 pixels Sound: 8-bit sound capable of driving stereo headphones or other stereo equipment through the sound jack
Electrical	Main battery: NiCad; 2.5 A/hr.; provides 2–3 hours of usage before recharging; 3 hr. recharge time; 500 power cycles capacity PRAM battery: 3 V lithium Power adapter: 110–220 VAC line voltage; 17 W; 50–60 Hz; US, Japanese, United Kingdom, Australian, and European versions
Physical	Height: 2.25 in. (5.7 cm) Width: 11.25 in. (28.6 cm) Depth: 9.3 in. (23.6 cm) Weight (with battery): 6.8 lb. (3.1 kg)
Environmental	Operating temperature: 50–104° F (10–40° C) Storage temperature: -13 to 140° F (-25 to 60° C) Relative humidity: 20–80% Altitude: 0–15,000 ft. (0–4722 m) Operational altitude: 0–10,000 ft. (0–3048 m)
Other	Fax/Data Modem: Internal 2400-baud modem with fax send at 9600 baud; 300/1200/2400 bps transmission rates; serial binary and asynchronous protocols; MNP 4,5 and V.42, V.42 bis error correction and data compression

Specifications—Macintosh PowerBook 160 and 180

Configuration	PowerBook 160: 4 MB PSRAM; FSTN display; 40/80/120 MB hard drive; 1.4 MB floppy drive; NiCad battery; AC adapter; microphone PowerBook 180: 4 MB PSRAM; math coprocessor; active-matrix display; 80/120 MB hard drive; 1.4 MB floppy drive; NiCad battery; AC adapter; microphone Options: PowerBook Express Modem; Fax/Data Modem; memory expansion kits; PowerBook battery recharger; HDI-30 SCSI system cable; HDI-30 SCSI disk adapter
Processor	Motorola 68030 microprocessor; 25 MHz on 160; 33 MHz on 180 Coprocessor (PowerBook 180 only): Motorola 68882 floating-point unit; 33 MHz Addressing: 32-bit internal registers, address bus, and data bus
Memory	RAM: 4 MB, expandable to 14 MB (using third-party SIMMs) ROM: 1 MB PRAM: 256 bytes VRAM: 128K of static video display memory Clock/calendar: Custom chip with long-life lithium battery
Disk Storage	Floppy drive: 19-mm high, 1.4 MB Apple SuperDrive Hard drive: 2.5-in. hard drive (many capacities)
I/O Interfaces	ADB: ADB port (max. of three ADB devices); 200 mA max. current draw for all ADB devices Serial: Two RS-422 serial ports; mini DIN-8 connectors SCSI: HDI-30 SCSI port with 1.5 MB/sec. transfer rate; supports max. of five external SCSI devices; does not provide termination power; connection to another computer requires HDI-30 SCSI system cable Floppy drive: HDI-20 port for connecting external floppy drives Sound: Monaural sound-in port; stereo sound-out headphone jack that plays CD audio tracks in stereo and computer-generated sounds in mono Video: Video-out port; 8-bit, 256-color video support; supports Macintosh monitors up to 16-in. color and VGA monitors Power adapter: Power adapter port Modem: Slot for optional modem Security: Slot for third-party security equipment
I/O Devices	Keyboard: Built-in keyboard with standard Macintosh layout; 63 keys domestic, 64 keys ISO; two-level tilt adjustment Trackball: 30 mm diameter, dual button; ADB interface Microphone: Electret, omnidirectional; output voltage of 4 mV, peak-to-peak

Sound and Video	Video display (PowerBook 160): 10-in. (25.4 cm) diagonal screen; flat-panel, film-compensated supertwist nematic (FSTN) liquid crystal display; CCFL on-demand backlight; 640 by 400 pixels Video display ((PowerBook 180): 10-in. (25.4 cm) diagonal screen; flat-panel, active matrix, liquid crystal display; CCFL on-demand backlight; 640 by 400 pixels Sound: 8-bit sound capable of driving stereo headphones or other stereo equipment through the sound jack
Electrical	Main battery: NiCad; 2.5 A/hr.; provides 2–3 hr. of usage before recharging; 3 hr. recharge time; 500 power cycles capacity PRAM battery: 3 V lithium Power adapter: 110–220 VAC line voltage; 19 W; 50–60 Hz; US, Japanese, United Kingdom, Australian, and European versions
Physical	Height: 2.25 in. (5.7 cm) Width: 11.25 in. (28.6 cm) Depth: 9.3 in. (23.6 cm) Weight (with battery): 6.8 lb. (3.1 kg)
Environmental	Operating temperature: 50–104° F (10–40° C) Storage temperature: -13 to 140° F (-25 to 60° C) Relative humidity: 20–80% Altitude: 0–15,000 ft. (0–4722 m) Operational altitude: 0–10,000 ft. (0–3048 m)
Other	Fax/Data Modem: Internal 2400-baud modem with fax send at 9600 baud; 300/1200/2400 bps transmission rates; serial binary and asynchronous protocols; MNP 4,5 and V.42, V.42 bis error correction and data compression Express Modem: Internal 14,400 baud modem with fax send and receive capability at 9600 baud; 300 to 14,400 bps data transmission rates; 2400/4800/7200/9600 bps fax transmission rates; full duplex operation; asynchronous or framed modes; V.42 (MNP 2-4) error correction; V.42 bis (4-to-1 compression) and MNP-5 (2-to-1 compression) data compression; requires 300K of system RAM SCSI Disk Adapter: Enables connection of a PowerBook computer to a desktop Macintosh (PowerBook appears as a hard drive on the desktop)

Reset, Interrupt, and Power Switches

Pressing the reset switch resets the power manager and the central processor and reboots the computer; information in system RAM disappears. Pressing the interrupt switch creates a system interrupt. Pressing the power button switches the computer on or wakes it from sleep. The table below summarizes the computer power states and the reset switch, interrupt switch, and power button functions.

Starting Power State	Action	Computer Response
Power off	Press power button	Boot
Power off	Press any key	Power off (no charge)
Power off	Connect power adapter	Charging
Power on	Issue shutdown command	Data saved, power off
Power on	Press power button	Data lost, power off
Power on	Press power button twice	Data lost, reboot
Power on	Press reset switch	Data lost, reboot
Power on	Press interrupt switch	Test monitor mode
Power on	Press both reset and interrupt	Data lost, reboot
Power on	Issue sleep command	Sleep
Sleep	Press any key except Caps Lock	Power on
Sleep	Press power button	Power on
Sleep	Detect very low power	Data lost, power off
Sleep	Remove battery	Data lost, power off

PowerBook 140/145/170

Interrupt Switch   Reset Switch   Power Button

PowerBook 160/180

Interrupt Switch   Reset Switch   Power Button

Figure 2   Reset Switch, Interrupt Switch, and Power Button

Before You Start

- Check the battery and power adapter. The parameter RAM battery does not support system RAM. Save RAM contents (use the Shut Down command) before removing the main battery.
- Check connections on internal and external cabling and on option cards.
- Use System 7.0.1 or later with PowerBook 140, 145, and 170 computers. Use System 7.1 or later with PowerBook 160 and 180 computers.
- Remove all option cards and disconnect external devices (printers, SCSI devices, additional ADB devices, and disk drives).
- Test the internal cables with a known-good system.

Things to Remember

- Install inverter shields on all PowerBook 140, 145, and 170 computers.
- When running the *Hard Disk Test* diagnostic to test the hard disk, operate the computer from the power adapter and do not select looping.
- Follow all electrostatic discharge precautions when working on the computer. The computer is very sensitive to ESD.
- When you attach the power adapter to the computer but do not plug the computer into a power source, a low-power dialog box appears.
- The battery desk accessory is a general indicator of the battery charge level. Use a voltmeter to determine the actual charge.
- PowerBook computers do not provide termination power. Terminate SCSI devices as shown in the table below.

	One External SCSI Device	Two or More External SCSI Devices
Without internal hard drive	Two terminators (both on external device)	Two terminators (one on first, one on last external device)
With internal hard drive	One terminator (on external device)	Two terminators (one on first, one on last external device)

Battery Verification

1. Disconnect the power adapter. Save RAM contents (use the Shut Down command) before removing the main battery. Otherwise, contents will be lost.

▲ Warning   **Do not short the battery. The battery may become hot enough to burn you.**

2. Remove the main battery.
3. Set the voltmeter range to 10 volts DC.
4. Hold the positive probe of the voltmeter to the positive side of the battery and the negative probe to the negative side of the battery (see Figure 3).
5. If the battery falls below **5.7 volts**, recharge the battery. If the battery will not recharge, replace it.

Positive Probe

Negative Probe

Figure 3   Battery Verification

Adapter Verification

1. Plug the power adapter into the wall source.
2. Set the voltmeter range to 10 volts DC.
3. Hold the positive probe of the voltmeter to the inside of the adapter plug and the negative probe to the outside of the adapter plug (see Figure 4).
4. If the voltage is not between **7.5–7.9 volts**, replace the adapter.

Caution **You cannot use a Macintosh Portable power adapter on a PowerBook computer, or vice versa. You will damage the computer if you try to use the power adapters interchangeably.**

Figure 4   Adapter Verification

Troubleshooting Flowchart

```
                    ┌─────────────┐
                    │   START     │
                    └──────┬──────┘
                           │
                           ▼
              ┌────────────────────────┐
              │   Reset the power      │
              │      manager.          │
              └───────────┬────────────┘
                          │
                          ▼
           ┌─────────────────────────────┐
           │  Press the power button to  │
           │ begin the startup sequence. │
           └─────────────┬───────────────┘
                         │
                         ▼
```

Do the startup tones sound? — No → **Does any video appear?** — No → 1. Replace the daughterboard. 2. Replace the motherboard.

Yes ↓ (from "Do the startup tones sound?")

Yes ↓ (from "Does any video appear?")

1. Check the cables.
2. Replace the interconnect board.
3. Replace the daughterboard.
4. Replace the motherboard.

Is the startup tone normal? — No → See Startup Problems in the Symptom/Cure Chart.

Yes ↓

1. Check the cables.
2. Replace the inverter board.
3. Replace the interconnect board.
4. Replace the display cable.
5. PowerBook 140, 145, 160:
   Replace the display.
   PowerBook 170, 180: Replace the display (international only) or return the computer to Apple.
6. Replace the daughterboard.
7. Replace the motherboard.

Does a gray pattern appear? — No → (points to list above)

Yes ↓

(1)

```
    ┌─┐                                                              ╭──────╮
    │1│                                                              │Go to │
    └─┘                                                              │Start │
     │                                                               ╰──────╯
     ▼                            ◇                       ┌─────────────────┐    ▲
     ◇                        Does                        │1. Replace the   │    │
   Does        No      the disk icon with      No         │   daughterboard.│    │
 the desktop ──────►  the flashing question ──────►       │2. Replace the   │────┘
  appear?              mark remain on the                 │   motherboard.  │
     ◇                      screen?                       └─────────────────┘
     │                        ◇
    Yes                       │
     │                       Yes
     │                        │
     │                        ▼
     │            ┌───────────────────────────────────────────────┐
     │            │1. Reset parameter RAM.                         │
     │            │2. Use HD SC Setup to update the SCSI driver.   │
     │            │3. Reinstall System 7.0.1 or later.             │
     │            │4. Replace the internal hard drive cable.       │
     │            │5. Replace the hard drive.                      │────►
     │            │6. Replace the motherboard.                     │
     │            │7. Replace the daughterboard.                   │
     │            └───────────────────────────────────────────────┘
     │
     ▼
     ◇            ┌───────────────────────────────────────────────┐
   Do the        │1. Reset the power manager.                     │
 trackball and   │2. Check the cables.                            │
 buttons function│3. Replace the trackball.                       │
  correctly?  ───┤4. Replace the keyboard.                        │────►
     ◇       No  │5. Replace the interconnect board.              │
     │           │6. Replace the daughterboard.                   │
    Yes          │7. Replace the motherboard.                     │
     │           └───────────────────────────────────────────────┘
     │
     ▼
 ┌──────────────────────┐
 │Insert a known-good disk│◄──────────────────────┐
 │into the floppy disk drive│                      │
 │and try to initialize it.│                       │
 └──────────────────────┘                          │
     │                                             │
     ▼                                             │
     ◇          ┌──────────────────────────────────┐
  Does the  No  │1. Replace the floppy drive cable.│
    disk    ────┤2. Replace the floppy drive.      │
 initialize?    └──────────────────────────────────┘
     ◇
     │
    Yes
     │
     ▼
 ╭─────────╮
 │  END    │
 ╰─────────╯
```

Symptom/Cure Chart

Startup Problems	Solutions
Computer gives startup chord followed by eight-tone error chord sequence	1. Reseat RAM expansion card and check connection. 2. Replace RAM expansion card. 3. Replace daughterboard. 4. Replace motherboard.
Computer gives startup chord, pauses, and then plays four-tone error chord sequence	1. Disconnect hard drive data cable and reboot. If startup chord is normal, reconnect cable and retest. 2. Replace hard drive. 3. Disconnect floppy drive cable and reboot. If startup chord is normal, reconnect cable and retest. 4. Replace floppy drive. 5. Replace motherboard.

Power Problems	Solutions
Screen is blank; computer doesn't respond	1. Restart computer. 2. Connect power adapter and try computer again in 3 or 4 minutes. 3. Try known-good, charged main battery. If computer now works, replace main battery. 4. Verify that interconnect board, daughterboard, and motherboard connections are secure. 5. If computer is in sleep mode, replace keyboard. 6. Replace interconnect board. 7. Replace daughterboard. 8. Replace motherboard.
After you remove main battery, some Control Panel settings are different	1. Check cables. 2. Replace interconnect board. 3. Replace daughterboard. 4. Replace motherboard.
Power adapter is plugged in and connected, but battery DA doesn't indicate charger is connected	1. If battery is fully charged, battery DA does not indicate charger is connected. 2. Verify that charger is connected properly. 3. Try known-good main battery. If battery now charges, replace main battery. 4. Try known-good adapter. If battery now charges, replace power adapter. 5. Verify that battery thermistor cable connection is secure. 6. Replace motherboard.
Low-power warning appears soon after you start to use computer	1. Battery needs recharging. Attach power adapter. 2. Make sure peripherals are low-power type. 3. Reduce use of floppy or hard drive, modem, sound, backlight, or other power-consuming devices, or connect power adapter. 4. Verify that battery is good. 5. Verify that power adapter is good. 6. Replace motherboard.

Computer runs when plugged into wall outlet, but doesn't function from battery; battery voltage is OK	1. Replace motherboard. 2. Return computer to Apple.

Video Problems | **Solutions**

Pixel never comes on or is always on	– PowerBook 170 and 180 active-matrix display: If more than five pixels do not come on or are always on, replace display (international only) or return computer to Apple.

Slight white line is always in middle of screen	– This is normal for the FSTN screen in PowerBook 140, 145, and 160. If screen is active-matrix (PowerBook 170 or 180), replace display (international only) or return computer to Apple.

Partial or full row of pixels is always on or never comes on	1. Check cables. 2. Add shim to display cable. 3. Replace display cable. 4. PowerBook 140, 145, and 160 FSTN display: Replace display. 5. Replace interconnect board. 6. Replace daughterboard. 7. PowerBook 170 and 180 active-matrix display: Replace display (international only) or return computer to Apple.

Display is very light or totally white	1. Adjust screen contrast setting. 2. Verify that display cable, inverter board, interconnect board, daughterboard, and motherboard connections are secure. 3. Replace inverter board. 4. Replace interconnect board. 5. Replace display cable. 6. PowerBook 140, 145, and 160 FSTN display: Replace display. 7. Replace daughterboard. 8. Replace motherboard. 9. PowerBook 170 and 180 active-matrix display: Replace display (international only) or return computer to Apple.

No display, but computer appears to be operating correctly	1. Adjust screen contrast setting. 2. Check display cable, inverter board, interconnect board, daughterboard, and motherboard connections. 3. Connect power adapter. 4. Replace inverter board. 5. Replace interconnect board. 6. Replace display cable. 7. PowerBook 140, 145, and 160 FSTN display: Replace display. 8. Replace daughterboard. 9. Replace motherboard. 10. PowerBook 170 and 180 active-matrix display: Replace display (international only) or return computer to Apple.

Screen flickers	– Add shim to display cable.

Brightness is not uniform	–	This effect is normal for the FSTN screen in PowerBook 140, 145, and 160. Diminish the effect by adjusting contrast and brightness. If screen is active-matrix (PowerBook 170 or 180), replace display (international only) or return computer to Apple.
Display dimmed or stopped working, but is OK now	–	If temperature is under 5° C or over 40° C, such reaction is normal for FSTN screen in PowerBook 140, 145, and 160.

Backlight doesn't operate

1. Check display cable, inverter board, interconnect board, daughterboard, and motherboard connections; verify that no cable is pinched or severed.
2. Replace inverter board.
3. Replace inverter display cable.
4. Replace interconnect board.
5. Replace display cable.
6. PowerBook 140, 145, and 160 FSTN display: Replace display.
7. Replace daughterboard.
8. Replace motherboard.
9. PowerBook 170 and 180 active-matrix display: Replace display (international only) or return computer to Apple.

Screen goes blank

1. Press any key to wake computer from system sleep.
2. Check display cable connection.
3. Reseat daughterboard
4. Replace daughterboard.

Floppy Drive Problems	**Solutions**

Audio and video present, but internal drive doesn't work

1. Try known-good floppy disk.
2. Check floppy drive cable connection.
3. Replace floppy drive cable.
4. Replace floppy drive.
5. Replace daughterboard.
6. Replace motherboard.

Disk initialization fails

1. Verify that you are using proper type of media.
2. Try known-good floppy disk.
3. Install inverter shield, if absent.
4. Check floppy drive cable connection.
5. Replace floppy drive cable.
6. Replace floppy drive.

Disk ejects while booting; display shows Mac icon with blinking "X"

1. Try known-good system disk.
2. Check that trackball or mouse button is working.
3. Check floppy drive cable connection.
4. Replace floppy drive cable.
5. Replace floppy drive.
6. Replace motherboard.

Disk doesn't eject	1.	Shut down computer, press and hold trackball or mouse button, and switch on computer.
	2.	Eject disk manually by pushing opened paper clip into hole under floppy drive slot.
	3.	Check floppy drive cable connection.
	4.	Replace floppy drive cable.
	5.	Replace floppy drive.
	6.	Replace daughterboard.
	7.	Replace motherboard.

Read/write/copy error	1.	Try known-good floppy disk.
	2.	Install inverter shield, if absent.
	3.	Check floppy drive cable connection.
	4.	Replace floppy drive cable.
	5.	Replace floppy drive.

Hard Drive Problems **Solutions**

Internal hard drive doesn't operate	1.	Disconnect all external SCSI devices.
	2.	Verify that internal SCSI hard drive cable is securely connected at both ends.
	3.	Use *HD SC Setup* to determine whether computer recognizes drive. If it does, try to reinitialize drive.
	4.	Replace internal hard drive cable.
	5.	Replace hard drive.
	6.	Replace motherboard.

Peripheral Problems **Solutions**

After you connect external SCSI device, computer no longer boots	1.	Switch on external SCSI device before starting computer.
	2.	Verify that external device is connected properly.
	3.	Verify that SCSI cable is terminated properly.
	4.	Verify that no SCSI devices have same address.
	5.	Verify that internal hard drive is good.
	6.	Use a known-good computer to verify external SCSI devices.
	7.	Replace motherboard.

Cursor doesn't move when you use trackball	1.	Press reset switch.
	2.	Check cable connections between trackball and keyboard, keyboard and interconnect board, interconnect board and daughterboard, and daughterboard and motherboard.
	3.	Connect low-power mouse and try to move cursor. If cursor moves, try using trackball and keyboard. If trackball does not move cursor, replace trackball. If keyboard does not move cursor, replace keyboard.
	4.	Replace interconnect board.
	5.	Replace daughterboard.
	6.	Replace motherboard.

Cursor doesn't move when you use mouse	1. Check mouse connection to ADB port. 2. Press reset switch. 3. Clean mouse ball and inside of mouse. 4. Replace mouse. 5. Replace motherboard.
Cursor intermittently doesn't move or moves erratically	1. Press reset switch. 2. Clean ball and internal rollers of trackball. 3. Check cables. 4. Replace trackball. 5. Replace keyboard. 6. Replace interconnect board. 7. Replace motherboard.
Cursor moves, but clicking trackball button has no effect	1. Press reset switch. 2. Check cable connections between trackball and keyboard, keyboard and interconnect board, interconnect board and daughterboard, and daughterboard and motherboard. 3. Replace trackball. 4. Replace keyboard. 5. Replace interconnect board. 6. Replace daughterboard. 7. Replace motherboard.
No response to any key on keyboard	1. Verify that computer is on. 2. If screen is blank and you are trying to bring computer out of system sleep, try resetting power manager. 3. Check keyboard connections to interconnect board and interconnect board connection to daughterboard. 4. Replace keyboard. 5. Replace interconnect board. 6. Replace daughterboard.
Device connected to external modem port doesn't work	1. Verify that **External Modem** is selected in CDEV. 2. Make sure system software is 7.0.1 or later for PowerBook 140, 145, and 170 or 7.1 or later for PowerBook 160 and 180. 3. Check that all cabling is correctly and securely attached. 4. Test device with known-good computer. 5. Replace daughterboard. 6. Replace motherboard.
I/O devices are unrecognized or garbage is transmitted and/or received	1. Make sure system software is 7.0.1 or later for PowerBook 140, 145, and 170 or 7.1 or later for PowerBook 160 and 180. 2. Verify that all cabling is correctly and securely attached. 3. If device is SCSI type, verify that it is properly terminated. 4. Verify that no SCSI devices have same address. 4. Test device with known-good computer. 5. Replace daughterboard. 6. Replace motherboard.

Known-good direct-connect printer doesn't print	1. Make sure system software is 7.0.1 or later for PowerBook 140, 145, and 170 or 7.1 or later for PowerBook 160 and 180. 2. Make sure that Chooser is set correctly. 3. Check cables. 4. Verify printer cable is securely attached. 5. Replace printer cable. 6. Try known-good printer. 7. Replace daughterboard. 8. Replace motherboard.
Known-good network printer doesn't print	1. Make sure system software is 7.0.1 or later for PowerBook 140, 145, and 170 or 7.1 or later for PowerBook 160 and 180. 2. Make sure Chooser is set correctly. 3. Check cables. 4. Verify that all printer cabling is securely attached. 5. Replace printer cable. 6. Try another printer. If printer works, computer is OK. Refer to network information on *Service Source* for further assistance. 7. Replace daughterboard. 8. Replace motherboard.

Internal Fax/Data Modem Problems	**Solutions**
Internal modem options don't appear in CDEV when modem is installed	1. Reseat modem board. 2. Make sure system software is 7.0.1 or later for PowerBook 140, 145, and 170 or 7.1 or later for PowerBook 160 and 180. 3. Replace modem board. 4. Replace motherboard.
Modem doesn't respond properly to AT command set instructions	1. Verify that baud rate and data format settings of communications application are compatible with internal modem and remote modem. 2. Check phone cord connection and operation. 3. Reseat modem board. 4. Make sure system software is 7.0.1 or later for PowerBook 140, 145, and 170 or 7.1 or later for PowerBook 160 and 180. 5. Replace modem board.
Strange mix of characters appears on screen	1. Verify that baud rate and data format settings of communications application are compatible with internal modem and remote modem. 2. Check phone cord connection and operation. 3. Reseat modem board. 4. Make sure system software is 7.0.1 or later for PowerBook 140, 145, and 170 or 7.1 or later for PowerBook 160 and 180. 5. Replace modem board. 6. Replace daughterboard. 7. Replace motherboard.

Modem doesn't respond to incoming call	1. If system doesn't respond to incoming call during sleep mode, verify that **Wake on Ring** option in CDEV is selected.
	2. Check phone cord connection and operation.
	3. Replace modem board.
	4. Replace motherboard.

| Modem connects but doesn't communicate with remote modem | – Verify that remote modem needs error correction (this is internal modem's default). If remote modem does not need error correction, disable error correction by typing **AT &Q0** (see *Macintosh PowerBook Fax/Data Modem User's Guide*). |

Modem interferes with system sound	1. Reseat modem board.
	2. Replace modem board.
	3. Replace interconnect board.
	4. Replace motherboard.

Modem has no sound output	1. Verify that Control Panel volume indicator is set above 0.
	2. Replace modem board.
	3. Replace interconnect board.
	4. Replace motherboard.

| **Miscellaneous Problems** | **Solutions** |

| Screen goes blank and computer shuts down every few minutes | – Computer is going into system sleep to conserve battery power. If computer is going into system sleep too often, adjust sleep delays in Control Panel or connect power adapter. |

| Some applications seem to run slower after few seconds | – Computer is switching to system rest. If system rest is interfering with the operation of application, connect power adapter. |

| Hard drive is slow to respond, or screen goes blank too often | – Computer is powering down hard drive or going into system sleep to conserve battery power. If hard drive is shutting downor system is going into system sleep too often, adjust sleep delays in Control Panel or connect power adapter. |

No sound from speaker	1. Verify that volume setting in Control Panel is 1 or above.
	2. Verify that no external speaker is plugged in.
	3. Check speaker connection to interconnect board, interconnect board connection to daughterboard, and daughterboard connection to motherboard.
	4. Replace interconnect board.
	5. Replace daughterboard.
	6. Replace motherboard.

Memory Upgrade

The standard configuration for the PowerBook 140 is 2 MB RAM; the standard configuration for the PowerBook 145, 160, 170, and 180 is 4 MB RAM. You can upgrade the amount of RAM by adding 2 MB, 4 MB, or (in the PowerBook 140 only) 6 MB RAM expansion cards. Figure 5 shows how to install a RAM expansion card.
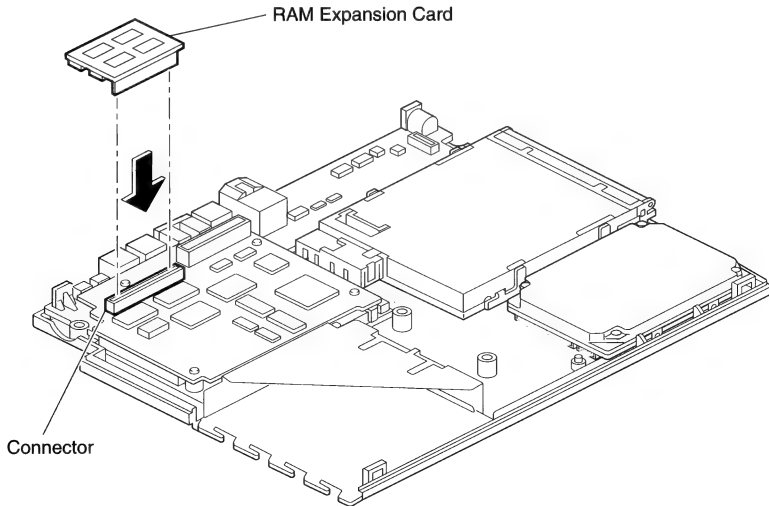
RAM Expansion Card

Connector

Figure 5   Inserting a RAM Expansion Card

To verify the memory upgrade, highlight the hard drive icon and select **Get Info** (on the Apple menu). The Get Info window will indicate whether virtual memory is off or on. If virtual memory is off, check the Total Memory listing; if virtual memory is on, check the Built-in Memory listing. The listing should read as follows:

4096K (with a 2 MB RAM expansion card installed)
6144K (with a 4 MB RAM expansion card installed)
8192K (with a 6 MB RAM expansion card installed)

If the amount of RAM is incorrect, replace the RAM expansion card. If the amount of RAM is still incorrect, return the computer to Apple.

Fax/Data Modem

The modem is a standard feature on the PowerBook 170; it is an option on the PowerBook 140, 145, 160, and 180. To remove the modem, follow the steps below.

Caution   **The components on the modem are very sensitive to ESD.   Follow ESD precautions with extra care when touching the modem.**

1. Remove the main battery, I/O door, and top case.
2. Remove the two screws holding the modem on the top of the motherboard.
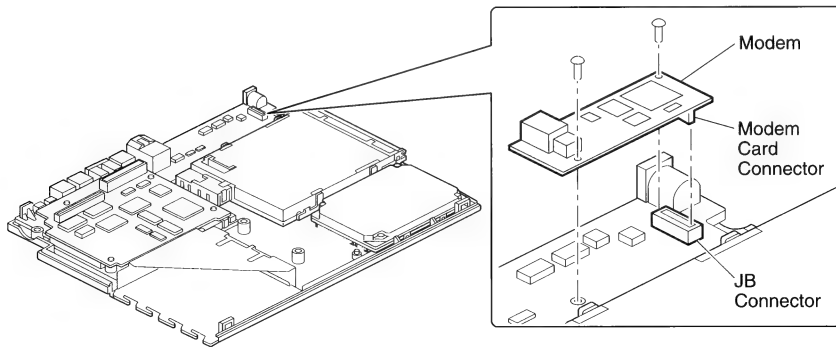3. Disconnect the modem from the motherboard (Figure 6).

Figure 6   Fax/Data Modem

When you install a modem,
- Remove the port cover to uncover the modem port.   (To remove the modem port cover, pinch the tabs together at their base (Figure 7) and push the cover through the computer's back panel from inside to outside.)
- Affix the FCC modem label and the DOC label to the inside of the I/O door.   Position the FCC modem label so that it aligns with the modem port and the DOC label so that it aligns with the HD-30 SCSI port.
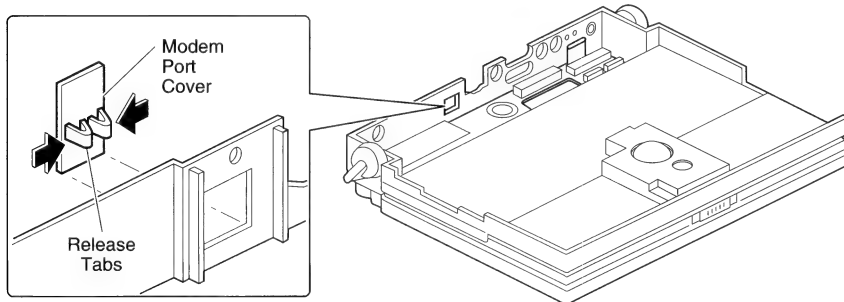

Figure 7   Modem Port Cover

Shim Installation

Some PowerBook displays may flicker, intermittently go black, or display two horizontal black lines. If you encounter any of these problems, try squeezing the right side of the display bezel. If squeezing the bezel causes the condition to improve or to worsen, install a shim on the display cable. The shim improves the connection between the connector fingers and the cable contacts.

Note   Do not install a shim onto a display cable that has been stamped with part number 936-0108.

1. Remove the main battery.
2. Remove the two plastic plugs and the two bezel mounting screws from the display.
3. Pull the display bezel down and away to release it from the mounting tabs at the top of the display. Lift the bezel off the display.
4. **PowerBook 140, 145, and 160 only** (You can disconnect the display cable from the PowerBook 170 and 180 displays without removing the display from the housing.)

    a. Cover the keyboard with a clean cloth or sheet or paper (Figure 8).

    b. Use a T-8 Torx driver to remove the four display mounting screws (one in each corner of the display).

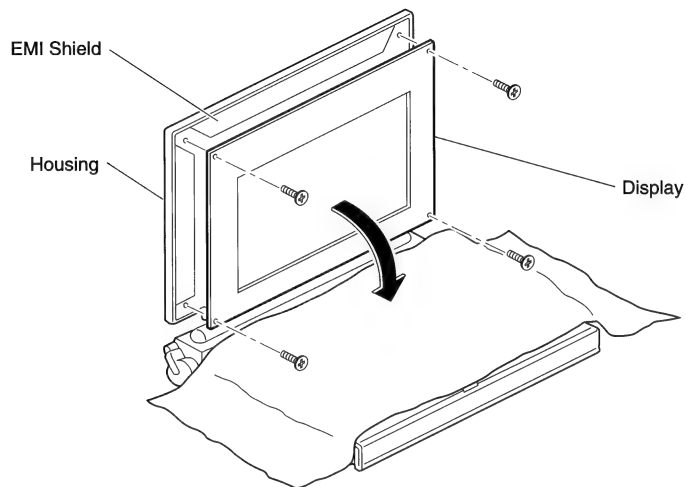   c. Remove the display from the EMI shield and housing and place the display face down on the keyboard.

Figure 8   Removing the Display

5.   Lift the locking tab on the display connector and disconnect the display cable (Figure 9).
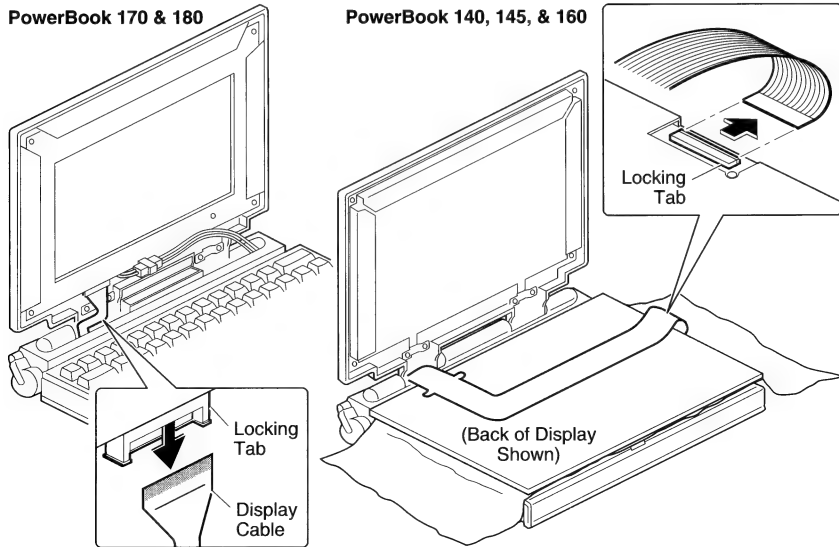

Figure 9   Opening the Locking Tab

6.   Remove the clear shim from its paper backing.
7.   Turn back the display cable and press the shim onto the back (the nonconductive side) of the display cable connector (Figure 10). Make sure that the shim is unwrinkled and flush with the edges of the cable and that it does not cover the connector traces.
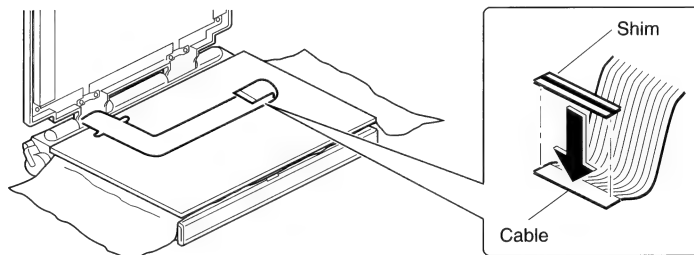

Figure 10   Installing the Shim

Display Compatibility Matrix

The PowerBook family includes several displays. Each of these displays requires a compatible inverter and display cable; the inverters, display cables, and displays are not interchangeable. Before ordering one of these parts, refer to the Display Compatibility Table below.

Display Compatibility Table

	Active Matrix PB 170	Active Matrix PB 180	FSTN, Rev. A PB 140/145 661-0706	FSTN, Rev. B PB 140/145 661-0681	FSTN, Rev. C PB 145/160 661-0745
Inverter	699-0273	922-0024	699-0271	699-0272	922-0025
Display Cable	630-6273	630-6273	936-0108	630-6272	936-0108
Inverter Cable	936-0106	936-0106	936-0106	936-0106	936-0106

Note   When you return a 661-0681 display from a PowerBook 140 computer, Apple will replace it with an FSTN Display Replacement Kit (part number 661-8745) This kit consists of the following parts:

Display, Rev. C	661-0745
Display Cable	936-0108
Housing	922-0044
Inverter	922-0025
Inverter Cable	936-0106

Macintosh Duo
System

Macintosh PowerBook Duo 210 and Duo 230

Display

Screw
Covers

Clutch
Cover
Kit

Top Case

Logic
Board

Keyboard

Expansion
Boards

Hard Drive
Assembly

CPU Stiffener/
Rear Cover

Trackball
Assembly

Bottom
Case

Battery
with Case

Figure 1   Macintosh PowerBook Duo 210 and Duo 230 Exploded View.

Specifications

Configurations	PowerBook Duo 210: 4 MB RAM; 80 MB hard drive; rechargeable battery; built-in speaker and microphone; AC power adapter PowerBook Duo 230: 4 MB RAM; 80 or 120 MB hard drive; rechargeable battery; built-in speaker and microphone; AC power adapter Options: Macintosh Duo Dock; Macintosh Duo MiniDock; PowerBook Duo Floppy Adapter; external 1.4 MB floppy drive; PowerBook Duo Express Modem; 4 and 8 MB memory expansion kits; external battery recharger; HDI-30 SCSI system cable; HDI-30 SCSI disk adapter
Processor	PowerBook Duo 210: Motorola 68030; 25 MHz PowerBook Duo 230: Motorola 68030; 33 MHz Addressing: 32-bit internal registers; 32-bit address/data bus supports 4 GB of address with justified 8-bit, 16-bit, and 32-bit data transactions
Memory	RAM: 4 MB DRAM soldered on the logic board, expandable to 24 MB; requires 70 ns or faster DRAM SIMMs ROM: 1 MB PRAM: 256 bytes Clock/calendar: CMOS custom chip supported by long-life (up to 2 years) lithium battery
Disk Storage	Floppy drive: External 1.4 MB floppy drive; requires Duo Floppy Adapter or Duo MiniDock Hard drive: 2.5 in., internal 80 or 120 MB hard drive; 17-mm high
I/O Interfaces	Docking connector: 152-pin PDS connector for attaching expansion devices; 32-bit expansion bus; designed for 5,000 connect/disconnect cycles Serial: RS-422 serial port; mini DIN-8 connector Modem (optional): Internal modem telephone jack; RJ-11 domestic; mini DIN-8 international
I/O Devices	Keyboard: Built-in standard Apple keyboard; 63 keys domestic, 64 keys ISO; caps-locked LED; soft power-on switch; 2.5-mm travel, 18-mm vertical and horizontal pitch; two-level tilt adjustment Trackball: 19-mm diameter, dual button; ADB interface Microphone: Built-in electret, omnidirectional microphone
Sound and Video	Video display: 9-in. (229 mm) diagonal screen; flat-panel, film-compensated supertwist nematic (FSTN) liquid crystal display; 1, 2, and 4 bits per pixel; 16-level grayscale at 4 bits per pixel; 640 by 400 pixels; CCFL on-demand backlight; adjustable brightness and contrast controls Sound: Apple sound chip provides four-voice/8-bit sound, sampled at 11 or 22 kHz; monophonic sound in and sound out

Electrical	Main battery: Ni-Hy (nickel-metal-hydride); 0.95 Ah; approximately 2–4 hr. of usage before recharging; 2-hr. recharge time; 500 power cycles capacity PRAM battery: 3 V lithium backup battery; 30 mAh Power adapter: 85–270 VAC line input voltage; 47–63 Hz; 24 VDC output; 1.04 A; can be used anywhere in the world with the appropriate power cord Battery recharger: Recharges one or two Ni-Hy batteries in approximately 2 hr.; attaches to the PowerBook Duo power adapter so customer can use computer and recharge batteries at the same time
Physical	Height: 10.9 in. (277 mm) Width: 8.5 in. (216 mm) Depth: 1.4 in. (36 mm) Weight: 4.25 lb. (1.9 kg)
Environmental	Operating temperature: 50–104° F (10–40° C) Storage temperature: -40 to 116° F (-40 to 47° C) Relative humidity: 20–95% noncondensing Altitude: 0–15,000 ft (0–4722 m)
Other	Express modem: Internal 14,400-baud modem with fax send and receive capability at 9600 baud; 300–14,400 bps data transmission rates; 2400/4800/7200/9600 bps fax transmission rates; full duplex operation; asynchronous or framed modes; V.42 compliance (MNP 2-4) for error correction; V.42 bis (4 to 1 compression) and MNP-5 (2 to 1 compression) for data compression; requires 300K of system RAM; built-in support for internal modem when in docking systems SCSI disk adapter: Enables connection between PowerBook Duo computer and desktop Macintosh (Duo system appears as a hard drive on the desktop)

Troubleshooting

When troubleshooting the PowerBook Duo 210 or 230, remove the PowerBook from the docking device and refer to "Symptom/Cure Chart" in this section. This symptom chart also troubleshoots floppy adapter, external floppy drive, and ADB problems.

Training Requirement (Domestic Repairers Only)

Only repair technicians who complete the Macintosh PowerBook Service Course can replace or install the display, modem, or logic board in the PowerBook Duo 210 or 230. Refer to Service Training in the Service Information Programs manual on *Service Source*.

Self-Threading Screws

Caution   **Improperly installed self-threading screws could damage the computer. Thread the screws properly and do not overtighten them.**

The PowerBook Duo 210 and 230 use both machine screws and self-threading screws. Be aware when you are replacing a self-threading screw, and follow these guidelines:

• Never overtighten self-threading screws.
• Before tightening-down a self-threading screw, back the screw off slightly to be sure it is threaded properly.
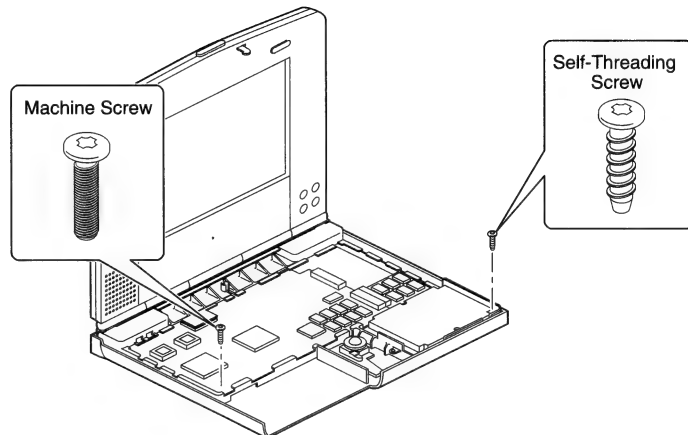

Figure 2   Replacing Self-Threading Screws

Symptom/Cure Chart

Startup Problems	Solutions
RAM failure occurs (eight-tone error chord sequence sounds after startup chord)	1. Check RAM expansion card connection. 2. Replace RAM expansion card. 3. Replace logic board.
Hardware failure occurs (four-tone error chord sequence sounds after startup chord)	1. Disconnect hard drive data cable and reboot system. If startup sequence is normal, reseat cable and retest. 2. Replace hard drive. 3. Disconnect system from floppy drive and reboot system. If startup sequence is normal, reseat cable and retest. 4. Replace floppy drive. 5. Replace logic board.

Power Problems	Solutions
Screen is blank; computer doesn't respond	1. Simultaneously press <Command> <Control> <Power On> keys to reset computer. 2. Connect power adapter and reboot computer in 3 to 4 minutes. 3. Try known-good, charged main battery. 4. Check all logic board cable connections. 5. Replace keyboard. 6. Replace logic board.
After you remove main battery, some Control Panel settings are different	– Replace backup battery.
Power adapter is plugged in, but battery DA doesn't indicate charger is connected	1. This is normal for fully charged battery. 2. Check power adapter connection. 3. Try known-good, charged main battery. 4. Try known-good power adapter. 5. Replace logic board.
Low-power warning appears	1. Recharge battery or attach power adapter. 2. Remove external devices. 3. Try known-good, charged main battery. 4. Try known-good power adapter. 5. Replace logic board.
Computer runs when plugged into wall outlet but not when using battery power; battery voltage is within tolerance	1. Replace main battery. 2. Replace logic board.

Video Problems	Solutions
Row or partial row of pixels never comes on or is always on	1. Check display cable connection. 2. Replace display. 3. Replace logic board.
Thin white line is always on at middle of screen	1. Adjust screen contrast. 2. For FSTN screens, a thin white line is normal.
Display is very light or totally white	1. Adjust screen contrast. 2. Check logic board cable connections. 3. Replace display. 4. Replace logic board.
No display, but computer appears to operate correctly	1. Adjust screen contrast. 2. Check logic board cable connections. 3. Connect power adapter. 4. Replace display. 5. Replace logic board.
Rainbow colors visible from extreme viewing angles	− Such colors are normal for FSTN screens.
Screen brightness is not uniform	− For FSTN screens, some irregularity in screen brightness is normal. Adjust contrast and brightness to diminish effect.
Display stopped working or dimmed but is fine now	− This reaction is normal for FSTN screens at extreme cold or hot temperatures (approximately under 5° C or over 40° C).
Backlight doesn't operate	1. Check display cable connection. 2. Replace display. 3. Replace logic board.
Screen goes blank	1. Press any key or press <Wake Up> key to wake computer from system sleep. 2. Check display cable connection.
Screen flickers	1. Some flickering is normal for grayscale displays. 2. Set display to 1-bit mode (black and white) in Monitors Control Panel. 3. Check display cable connection. 4. Replace display. 5. Replace logic board.

**External Floppy
Drive Problems**   **Solutions**

Audio and video   1. Check floppy-adapter-to-PowerBook connection.
present, but   2. Try known-good floppy disk.
external floppy   3. Check floppy drive cable connection.
drive doesn't   4. Replace floppy drive cable.
operate   5. Replace floppy adapter.
                         6. Replace floppy drive.
                         7. Replace logic board.

Disk ejects while   1. Try known-good system disk.
booting; display   2. Verify that trackball or mouse button is not stuck.
shows Mac icon   3. Check floppy drive cable connection.
with blinking "X"   4. Replace floppy drive cable.
                         5. Replace floppy adapter.
                         6. Replace floppy drive.
                         7. Replace logic board.

Disk doesn't   1. Switch off system. To eject disk, hold trackball or mouse
eject   button down while you switch system on.
                         2. Insert straightened paper clip into hole next to drive opening
                            and eject disk.
                         3. Check floppy drive cable connection.
                         4. Replace floppy drive cable.
                         5. Replace floppy adapter.
                         6. Replace floppy drive.
                         7. Replace logic board.

Disk initialization   1. Verify that you are using correct media.
fails   2. Try known-good floppy disk.
                         3. Check floppy drive cable connection.
                         4. Replace floppy drive cable.
                         5. Replace floppy adapter.
                         6. Replace floppy drive.

Read/write/copy   1. Verify that you are using correct media.
error   2. Try known-good floppy disk.
                         3. Check floppy drive cable connection.
                         4. Replace floppy drive cable.
                         5. Replace floppy adapter.
                         6. Replace floppy drive.

Hard Drive Problems **Solutions**

Internal PowerBook   1. Check internal hard drive cable connection.
hard drive doesn't   2. Replace internal hard drive cable.
operate   3. Run *Macintosh Hard Disk Test*.
                         4. Use *HD SC Setup* to reinitialize drive.
                         5. Replace internal hard drive.
                         6. Replace logic board.

Peripheral Problems	Solutions
Cursor doesn't move when you are using trackball	1. Simultaneously press <Command> <Control> <Power On> keys to reset computer. 2. Clean ball and rollers of trackball. 3. Make sure display switch cable and battery cable are not impeding trackball. 4. Check logic board cable connections. 5. Replace trackball. 6 Replace logic board.
Cursor doesn't move, or moves erratically	1. Clean ball and rollers of trackball. 2. Replace trackball. 3. Replace logic board.
Cursor moves, but clicking trackball button has no effect	1. Simultaneously press <Command> <Control> <Power On> keys to reset computer. 2. Check logic board cable connections. 3. Replace trackball. 4. Replace logic board.
No response to any key on keyboard	1. Press <Power On> key or power button. 2. Adjust Battery Conservation setting in Control Panel. 3. Check keyboard cable connection. 4. If you are using floppy adapter and external keyboard, replace keyboard cable. 5. Replace floppy adapter. 6. Replace keyboard. 7. Replace logic board.
Cursor doesn't move when you are using floppy adapter and mouse	1. Check floppy adapter and mouse connections. 2. Simultaneously press <Command> <Control> <Power On> keys to reset computer. 3. Clean mouse ball and inside mouse. 4. Replace mouse. 5. Replace floppy adapter. 6. Replace logic board.
Known-good serial printer doesn't print	1. Verify that System is 7.1 or later. 2. Verify that Chooser and Control Panel settings are correct. 3. Check cables. 4. Replace printer interface cable. 5. Try known-good printer. 6. Replace logic board.
Known-good networked printer doesn't print	1. Verify that System is 7.1 or later. 2. Verify that Chooser and Control Panel settings are correct. 3. Check cables. 4. Replace printer interface cable. 5. Try known-good printer. If printer works, troubleshoot network. Refer to Networks manual on *Service Source*. 6. Replace logic board.

Device connected to mini DIN-8 port doesn't work	1. Verify that **External Modem** is selected in Control Panel. 2. Verify that System is 7.1 or later. 3. Check cables. 4. Test device with known-good computer. 5. Replace logic board.
I/O devices are unrecognized or garbage is transmitted or received	1. Verify that System is 7.1 or later. 2. Check floppy adapter and cable connections. 3. Test device with known-good computer. 4. Replace logic board.

Internal Modem Problems	**Solutions**
Internal modem options don't appear in CDEV	1. Verify that System is 7.1 or later. 2. Remove and reseat modem interface board. 3. Replace modem card. 4. Replace logic board.
Modem doesn't respond properly to AT command set instructions	1. Verify that baud rate and data format settings of communications application are compatible with internal and remote modem. 2. Check phone cord connection and operation. 3. Verify that System is 7.1 or later. 4. Remove and reseat modem card. 5. Replace modem card.
Strange mix of characters appears on screen	1. Verify that baud rate and data format settings of communications application are compatible with internal and remote modem. 2. Check phone cord connection and operation. 3. Verify that System is 7.1 or later. 4. Remove and reseat modem card. 5. Replace modem card. 6. Replace logic board.
Modem interferes with system sound	1. Remove and reseat modem card. 2. Replace modem card. 3. Replace logic board.
Modem doesn't respond to incoming call	1. If computer is in sleep mode, verify that **Answer Calls** is selected in PowerBook Control Panel. 2. Check phone cord connection and operation. 3. Replace modem card. 4. Replace logic board.
Modem has no sound output	1. Verify that Control Panel volume setting is 1 or higher. 2. Replace modem card. 3. Replace logic board.

| Modem connects but doesn't communicate with remote modem | 1. Verify that remote modem needs error correction (error correction is internal modem default). |
| | 2. Type **AT &Q0** to disable error correction. |

Miscellaneous Problems	**Solutions**
Screen goes blank and computer shuts down every few minutes	1. Adjust Battery Conservation setting in Control Panel.
	2. Connect power adapter.
Application seems to run slower after few seconds	1. Adjust Battery Conservation setting in Control Panel.
	2. Connect power adapter.
Hard drive is slow to respond, or screen goes blank too often	1. Adjust Battery Conservation setting in Control Panel.
	2. Connect power adapter.
No sound from speaker	1. Verify that volume setting in Control Panel is 1 or above.
	2. Check display cable connection.
	3. Replace display.
	4. Replace logic board.

Logic Board Upgrades

Both 4 MB and 8 MB DRAM expansion cards and a 14,400 baud modem are available from Apple for the PowerBook Duo 210 and 230 computers.

Caution **The Macintosh Duo Dock contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap and use a grounded workbench pad.**

Memory Upgrade

1. Remove the main battery and keyboard.
2. Hold the DRAM expansion card by the edges and connect it to logic board connector J9.

Note **To verify the upgrade, check the Total Memory message or the Built-in Memory message (for systems with virtual memory switched on). Total memory should be 4 MB of DRAM plus the amount of DRAM on the expansion card.**

Modem Upgrade

1. Remove the main battery, keyboard, clutch covers, display and top case, hard drive, backup battery, trackball, CPU stiffener, and logic board.
2. Remove the modem cap from the rear cover.
3. Disconnect the on/off board from logic board connector J6.
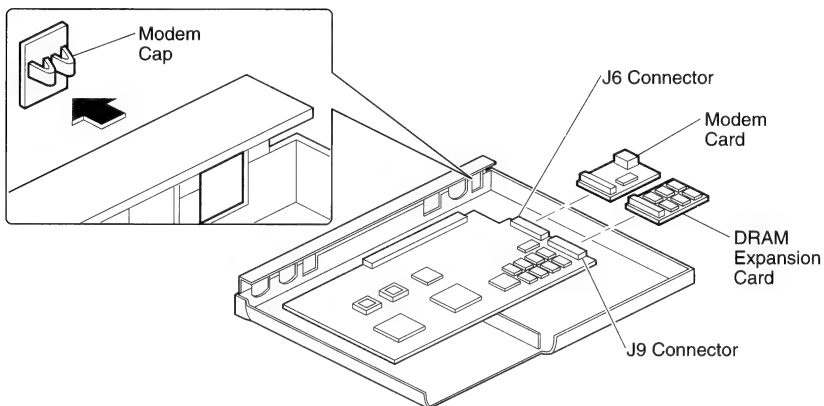4. Hold the modem card by the edges and connect it to connector J6.

Figure 3   Logic Board Upgrades

Battery Verification

The battery desk accessory is a general indicator of the battery charge. Use a voltmeter to determine the actual charge. Refer to the following procedure.

▲Warning **Return undamaged, dead Ni-Hy batteries to Apple—do not discard dead batteries with other waste. If the battery is damaged, do not return it to Apple. Dispose of damaged batteries according to local ordinances.**

1. Remove the main battery.
2. Set voltmeter to the 20 volts DC scale.
3. Touch the positive probe of the voltmeter to the positive terminal and the negative probe to the negative terminal.
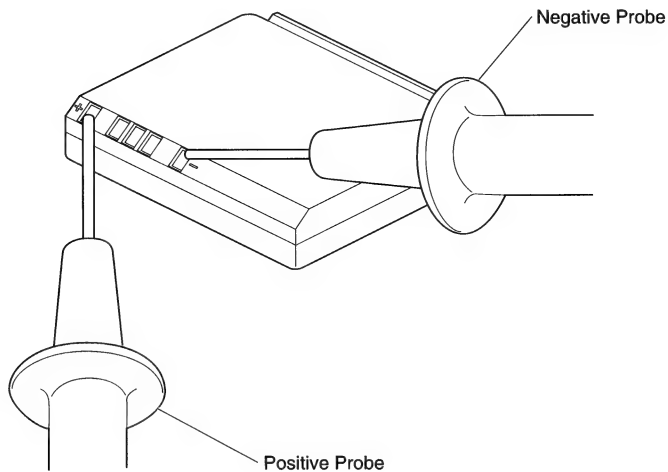4. If the reading is not 12 volts, recharge the battery. If the reading remains below 6 volts, replace the battery.

Negative Probe

Positive Probe

Figure 4   Battery Verification

AC Adapter Verification

The AC adapter should be checked both with power switched off to the PowerBook and with power switched on (under load).

1. Plug in the AC adapter to a wall socket and connect the adapter plug to the PowerBook.
2. Set the voltmeter to the 200 volts DC scale.
3. Touch the negative voltmeter probe to the contact nearest the power plug and the positive probe to the adjacent contact.
4. If the reading is not 24–25 volts, replace the adapter.
5. Also check the AC adapter under load. Switch on the PowerBook and repeat the voltmeter check in steps 1–4. If the reading drops more than 1–2 volts, replace the adapter.

Figure 5   AC Adapter Verification

Macintosh
Duo Dock

Release Mechanism
Mounting Screw

Release
Mechanism

Modem
Interface
Card

Top Cover

VRAM
SIMM

NuBus
Adapter
Board

Logic
Board
Assembly

Subassembly

Power
Supply

Base

Figure 1   Macintosh Duo Dock Exploded View

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* The plastic internal subassembly includes an HDA cable, HDA power cable, and floppy drive cable.

Specifications

Configuration	Standard features: 1.4 MB floppy drive; ergonomic mouse; extended keyboard; external microphone; 100 lb. monitor support case; two security keys; PowerLatch docking Extended features: Motorola 68882 math coprocessor; 512K VRAM SIMM; 230 MB hard drive Options: 68882 math coprocessor; 512K VRAM SIMM; 3.5 in., 1-in.-high SCSI hard drive (many capacities); HDI-30 SCSI system cable; Ethernet NuBus card; modem expander (domestic or international telephone jack)
Processor	Motorola 68882 floating point coprocessor; 25 MHz Addressing: 32-bit internal registers; 32-bit address bus; 32-bit data bus
Memory	ROM: Configuration ROM (differentiates between docking devices) VRAM: 512K, upgradeable to 1 MB
Disk Storage	Floppy drive: Internal 1.4 MB floppy drive; SWIM II MFM/GCR disk controller chip Hard drive (optional): 3.5 in., 1-in.-high SCSI hard drive (many capacities); internal 50-pin SCSI connector; external HDI-30 SCSI port; supports up to six SCSI devices
I/O Interfaces	Docking connector: Internal, 152-pin PDS connector to PowerBook Duo 210/230 NuBus: Two internal NuBus slots; two 15 W cards or one each at 25 W and 5 W Serial: Two RS-422 serial ports; mini DIN-8 connectors ADB: ADB port (recommended max. of three low-speed, synchronous ADB devices); mini DIN-4 connector; 200 mA max. current draw for all ADB devices SCSI: HDI-30 SCSI port with 1.5 MB/sec. transfer rate; supports max. of six devices Video: DB-15 connector supports Macintosh and VGA monitors (requires 15-pin to VGA adapter) Sound: One sound-output port for external audio amplifier Modem: Pass-through telephone jack for optional internal (PowerBook) modem; RJ-11 domestic, mini DIN-8 international
I/O Devices	Keyboard: Apple Keyboard; Apple Extended Keyboard Mouse: ADB mouse with mechanical tracking; optical shaft or contact encoding at 3.94 ± 0.39 pulse per mm (100 ± 10 pulses per in.) of travel Microphone: External electret, omnidirectional microphone; output voltage of 4 mV, peak to peak Speaker: 16 ohm magnetic, moving coil speaker Video support: 512K of built-in video; optional additional 512K VRAM SIMM; supports all Macintosh monitors up to 16-in. color; supports VGA monitors (requires NuBus card); supports 256 colors standard, expandable to 32,000 colors

Electrical	Power supply: Universal AC power supply; 85–270 VAC; provides 75 W continuous power, 85 W surge power; 47–63 Hz single phase input line frequency; charges PowerBook Duo 210/230 battery and powers Duo Dock
Physical	Height: 4.7 in. (121 mm) Width: 12.25 in. (311 mm) Depth: 16.25 in. (413 mm) Weight: 13.1 lb. (5.95 kg) without hard drive
Environmental	Operating temperature: 50–104° F (10–40° C) Storage temperature: -40 to 116° F (-40 to 47° C) Relative humidity: 20–95% noncondensing Altitude: 0–15,000 ft (0–4722 m)
Other	Modem (domestic): Telephone line interface (DAA) circuitry; RJ-11 connector Modem (international): Support for external telephone line interface (DAA) circuitry; mini DIN-8 connector Docking motor: Motorized injection/ejection mechanism draws the PowerBook Duo computer into the Duo Dock and ejects the system from the Duo Dock; DC motor operates at 5 rpm and provides 16–30 lb. of pull-in force Security: Key locking device at left front of unit locks PowerBook Duo computer into the Duo Dock; each lock is unique (no master key is available; 125 key combinations); key codes will be released to locksmiths; hook at rear of monitor stand can be used with Kensington mechanism to lock Duo Dock to the desktop

Troubleshooting

When troubleshooting the Macintosh Duo Dock, insert the PowerBook into the Duo Dock and refer to "Symptom/Cure Chart" in this section.

SCSI ID Numbers

The Macintosh Duo Dock supports up to six SCSI devices. Use an HDI-30 SCSI system cable to connect external SCSI devices to the Duo Dock. To avoid conflicting ID numbers, assign external SCSI devices numbers between 2 and 6. (The hard drive inside the PowerBook has SCSI ID number 0, and, if installed, the hard drive inside the Duo Dock has ID number 1.)

Caution   **When making SCSI connections, always switch off power to all devices in the chain.**

SCSI Termination

The Macintosh Duo Dock has a built-in SCSI terminator.

To terminate a SCSI chain that is connected to the dock, attach one external terminator to the last device in the chain (or connect a SCSI device with built-in termination as the last device in the chain).

Note   **SCSI devices from other vendors may have built-in terminators. If more than one SCSI device in the chain has built-in terminators, you may need to remove the extra internal terminators.**

Symptom/Cure Chart

Startup Problems	Solutions
RAM failure occurs (eight-tone error chord sequence sounds after startup chord)	1. Eject PowerBook Duo 210/230. Reboot and troubleshoot computer only. 2. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.
Hardware failure occurs (four-tone error chord sequence sounds after startup chord)	1. Eject PowerBook Duo 210/230. Reboot and troubleshoot computer only. 2. Disconnect hard drive data cable, install standard Apple SCSI terminator, and reboot system. If startup sequence is normal, reseat cable, remove terminator, and retest. If failure recurs, replace hard drive. 3. Disconnect floppy drive cable and reboot system. If startup sequence is normal, reseat cable and retest. If hardware failure recurs, replace floppy drive. 4. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.

Power Problems	Solutions
System doesn't respond	1. Eject PowerBook Duo 210/230. Reboot and troubleshoot computer only. 2. Check all Duo Dock logic board cable connections. 3. Replace Duo Dock power supply. 4. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.
System intermittently crashes or locks up	1. Verify System is 7.1 or later. 2. Verify that you are using known-good software. 3. Eject PowerBook Duo 210/230. Reboot and troubleshoot computer only. 4. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor. 5. Replace Duo Dock power supply.

Video Problems	Solutions
No external display, but computer appears to operate correctly	1. Adjust screen contrast. 2. Reseat video cable. 3. Replace video cable. 4. Replace video interface card (if installed). 5. Replace VRAM SIMM (if installed). 6. Try known-good external display. If now OK, replace and troubleshoot original display. 7. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.

Raster or video display problems at external monitor	1. Reseat video cable. 2. Replace video cable. 3. Replace video interface card (if installed). 4. Replace VRAM SIMM (if installed). 5. Try known-good external display. If now OK, replace and troubleshoot original display. 6. Eject PowerBook Duo 210/230. Reboot and troubleshoot computer only. 7. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.

Floppy Drive Problems

Solutions

Audio and video present, but external floppy drive doesn't operate	1. Try known-good floppy disk. 2. Check floppy drive cable connection. 3. Replace floppy drive cable. 4. Replace floppy drive. 5. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.
Disk ejects while booting; display shows Mac icon with blinking "X"	1. Try known-good system disk. 2. Verify that mouse button is not stuck. 3. Check floppy drive cable connection. 4. Replace floppy drive cable. 5. Replace floppy drive. 6. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.
Disk doesn't eject	1. Switch off system. To eject disk, hold mouse button down while you switch system on. 2. Insert straightened paper clip into hole next to drive opening and eject disk. 3. Check floppy drive cable connection. 4. Replace floppy drive cable. 5. Replace floppy drive. 6. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.
Disk initialization fails	1. Verify that you are using correct media. 2. Try known-good floppy disk. 3. Check floppy drive cable connection. 4. Replace floppy drive cable. 5. Replace floppy drive.
Read/write/copy error	1. Verify that you are using correct media. 2. Try known-good floppy disk. 3. Check floppy drive cable connection. 4. Replace floppy drive cable. 5. Replace floppy drive.

Hard Drive Problems   Solutions

Internal PowerBook   –   Eject PowerBook 210/230. Reboot and troubleshoot
hard drive doesn't   computer only.
operate

Internal Duo   1.   Check internal hard drive cable connection.
Dock hard   2.   Replace internal hard drive cable.
drive doesn't   3.   Run *Macintosh Hard Disk Test*.
operate   4.   Use *HD SC Setup* to reinitialize drive.
                      5.   Replace internal Duo Dock hard drive.
                      6.   Replace Duo Dock logic board. Retain VRAM SIMMs and
                            math coprocessor.

Internal hard   1.   Make sure external devices have unique switch settings
drive works,   between 2 and 6.
but external   2.   Make sure SCSI chain is terminated at last device only.
SCSI device   3.   Replace external SCSI terminator.
doesn't   4.   Troubleshoot external SCSI device.

Drive doesn't   1.   Restart system.
appear   2.   Verify that SCSI devices have unique addresses.
on desktop   3.   Use *HD SC Setup* to initialize drive.

Peripheral Problems   Solutions

Cursor doesn't   1.   Simultaneously press <Command> <Control> <Power On>
move, or moves   keys to reset computer.
erratically   2.   Check ADB connections.
                      3.   Inspect and clean mouse, if necessary.
                      4.   If mouse was connected to keyboard, try in ADB port. If OK,
                            replace keyboard.
                      5.   Replace mouse.
                      6.   Replace Duo Dock logic board. Retain VRAM SIMMs and
                            math coprocessor.

Cursor moves,   1.   Replace mouse.
but clicking   2.   Replace Duo Dock logic board. Retain VRAM SIMMs and
mouse button   math coprocessor.
has no effect

No response   1.   Press <Power On> key or power button.
to any key   2.   Check keyboard cable connection.
on keyboard   3.   Replace keyboard cable.
                      4.   Replace keyboard.
                      5.   Replace Duo Dock logic board. Retain VRAM SIMMs and
                            math coprocessor.

Can't double-click to open application, disk, or server	1. Remove any multiple system files.
	2. Inspect and clean mouse, if necessary.
	3. Clear parameter RAM. Hold down <Shift> <Option> <P> <R> during startup but before "Welcome to Macintosh" appears.
	4. If mouse was connected to keyboard, try in ADB port. If OK, replace keyboard.
	5. Replace mouse.
	6. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.

After you connect external SCSI device, computer doesn't boot	1. Switch on external SCSI device before starting computer.
	2. Check cable connections.
	3. Verify that standard Apple terminator terminates SCSI chain.
	4. Verify that SCSI select switch setting on external device is unique.
	5. Verify operation of internal hard drive.
	6. Try known-good external SCSI device.
	7. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.

Known-good ImageWriter, ImageWriter II, or LQ doesn't print	1. Verify that System is 7.1 or later.
	2. Verify that Chooser and Control Panel settings are correct.
	3. Check cables.
	4. Replace printer interface cable.
	5. Try known-good printer.
	6. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.

Known-good LaserWriter doesn't print	1. Verify that System is 7.1 or later.
	2. Verify that Chooser and Control Panel settings are correct.
	3. Check cables.
	4. Replace printer interface cable.
	5. Try known-good printer. If printer works, troubleshoot network. Refer to Networks manual on *Service Source*.
	6. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.

Device connected to external modem port doesn't work	1. Verify that External Modem is selected in Control Panel.
	2. Verify that System is 7.1 or later.
	3. Check cables.
	4. Test device with known-good computer.
	5. Eject PowerBook and test device at PowerBook external modem/printer port.
	6. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.

I/O devices are unrecognized or garbage is transmitted or received	1. Verify that System is 7.1 or later. 2. Check cables. 3. Verify that SCSI devices are terminated properly. 4. Verify that SCSI select switch setting on external device is unique and between 2 and 6. 5. Test device with known-good computer. 6. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.
Internal Modem	**Solutions**
Internal modem options don't appear in CDEV	1. Verify that System is 7.1 or later. 2. Remove and reseat modem interface board. 3. Eject PowerBook and test internal modem. 4. Replace modem interface board. 5. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.
Modem doesn't respond properly to AT command set instructions	1. Verify that baud rate and data format settings of communications application are compatible with internal modem and remote modem. 2. Check phone cord connection and operation. 3. Verify that System is 7.1 or later. 4. Remove and reseat modem interface board. 5. Eject PowerBook and test PowerBook internal modem. 6. Replace modem interface board. 7. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.
Strange mix of characters appears on screen	1. Verify that baud rate and data format settings of communications application are compatible with internal modem and remote modem. 2. Check phone cord connection and operation. 3. Verify that System is 7.1 or later. 4. Remove and reseat modem interface board. 5. Eject PowerBook and test PowerBook internal modem. 6. Replace modem interface board. 7. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.
Modem doesn't respond to incoming call	1. If computer is in sleep mode, verify that **Answer Calls** is selected in Remote Access Setup control panel. 2. Check phone cord connection and operation. 3. Eject PowerBook and test PowerBook internal modem. 4. Replace modem interface board. 5. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.

Modem interferes with system sound	1. Remove and reseat modem interface board.
	2. Eject PowerBook and test PowerBook internal modem.
	3. Replace modem interface board.
	4. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.

Modem has no sound output	1. Verify that Control Panel volume setting is 1 or higher.
	2. Eject PowerBook and test PowerBook internal modem.
	3. Replace modem interface board.
	4. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.

| Modem connects but doesn't communicate with remote modem | 1. Verify that remote modem needs error correction (error correction is internal modem default). |
| | 2. Type **AT &QO** to disable error correction. |

Miscellaneous Problems	**Solutions**
Can't insert computer into Dock	1. Unlock dock and insert computer.
	2. Open I/O door on computer and insert computer.

Can't eject computer from Dock	1. Unlock dock and press eject button again.
	2. If no power to dock, insert dock key or small screwdriver into square hole on side of dock and press to manually eject computer.
	3. Replace ejector assembly.
	4. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.

No sound from speaker	1. Verify that volume setting in Control Panel is 1 or above.
	2. Check speaker-to-logic-board cable connection.
	3. Replace Duo Dock logic board. Retain VRAM SIMMs and math coprocessor.

| Ejects computer when you attempt to start up from keyboard | – Shut down PowerBook and insert again. |

Logic Board Upgrades

The Macintosh Duo Dock has 512K of video RAM soldered on the logic board. You can increase the amount of VRAM to 1 MB by installing a 512K VRAM SIMM in SIMM slot connector J9. Use only 100 ns or faster VRAM SIMMs. You can also add a Motorola 68882 math coprocessor to the logic board, thereby increasing overall system performance.

Caution   **The Macintosh Duo Dock contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap and use a grounded workbench pad.**

VRAM SIMM Upgrade

1. Remove the cover.
2. Grasp the VRAM SIMM by its edges with the contacts pointing down. Insert the SIMM at an angle into SIMM slot connector J9.
3. Push back on the SIMM until it snaps into place.

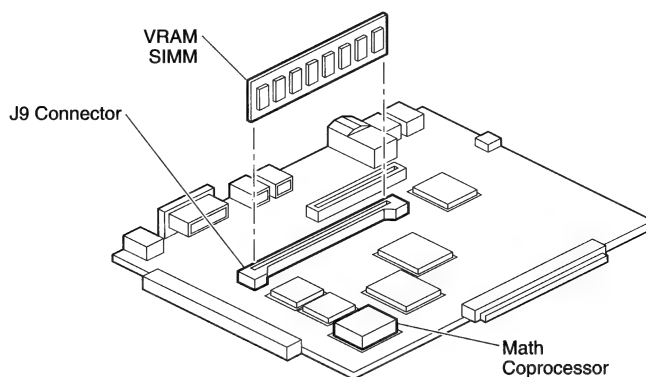**Figure 2   VRAM SIMM**

Math Coprocessor Upgrade

1. Remove the cover.
2. Position the math coprocessor with the beveled edge of the chip toward the front of the dock.
3. Align the pins in the 68882 socket and gently press the chip into the socket.

Modem Interface Card

The modem interface card provides telephone line interface (DAA) circuitry for PowerBook Duo 210 and 230 computers with an internal modem. To address the differences in telephone interfaces and specifications, Apple provides both domestic and international versions of this card.

Caution   **The Macintosh Duo Dock contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap and use a grounded workbench pad.**

1. Remove the cover.
2. Remove the modem port cover from the subassembly.
3. Insert the telephone jack into the modem port and position the modem interface card on the chassis. Press the modem connector onto DAA connector J10.
4. Using a T-6 Torx driver, install the two modem card mounting screws.
5. In Japan only, install a jumper on modem interface card connector J3. (A jumper is included with every modem interface card.)
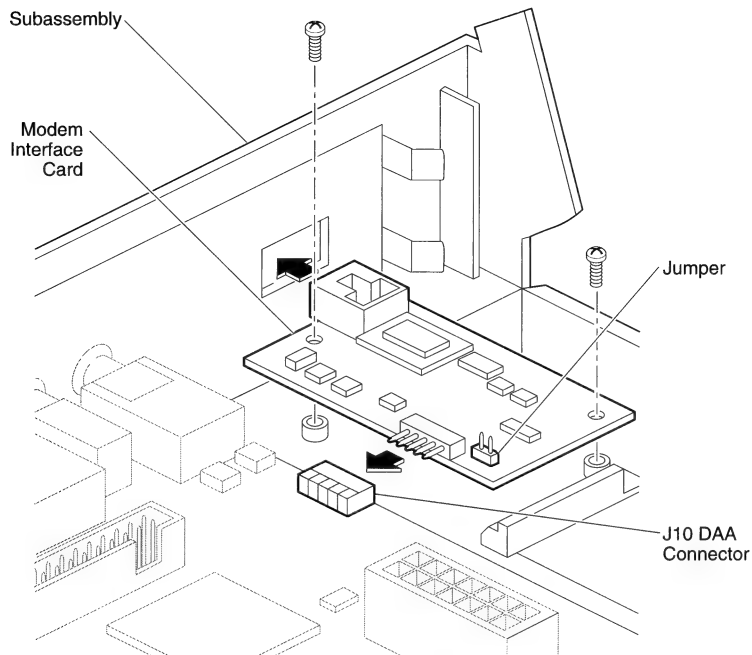

Figure 3   Modem Interface Card Installation

Hard Drive Upgrade

Any 3.5-inch, 1-inch-high hard drive can be installed in the hard drive bay in the Macintosh Duo Dock.

Caution   **The Macintosh Duo Dock contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap and use a grounded workbench pad.**

1. Remove the cover, release mechanism, subassembly, and floppy drive.
2. Position the hard drive adjacent to the hard drive bay on the underside of the subassembly. Route the hard drive data and power cables as shown in Figure 4. Hook the cables beneath the cable clamps and push the cable connectors through the subassembly access hole.
3. Lower and push down the hard drive until it snaps into place.
4. Replace the floppy drive and subassembly.
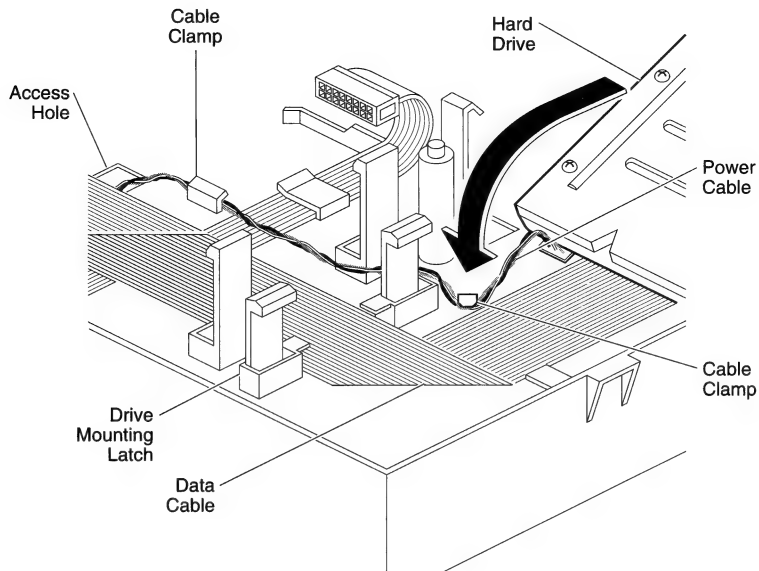5. Connect the hard drive data cable to logic board connector J8 and the hard drive power cable to connector J14.

Figure 4   Hard Drive Installation

NuBus Expansion Cards

Two standard NuBus expansion card slots are located on the underside of the Duo Dock subassembly. Install the first NuBus card in the lower slot (which is the upper slot when the dock is upright) so you won't have to remove this card when you add a second NuBus card later.

Caution **The Macintosh Duo Dock contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap and use a grounded workbench pad.**

1. Remove the cover, release mechanism, and subassembly.
2. Remove the appropriate NuBus slot cover from the subassembly.
3. Remove the NuBus card guide.
4. Position the NuBus card in the appropriate slot and press together the NuBus connectors.
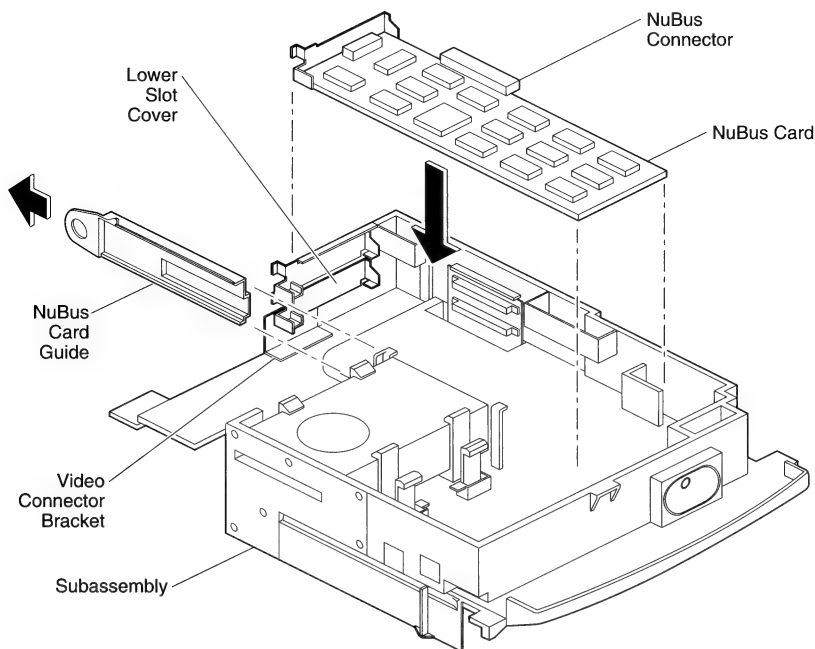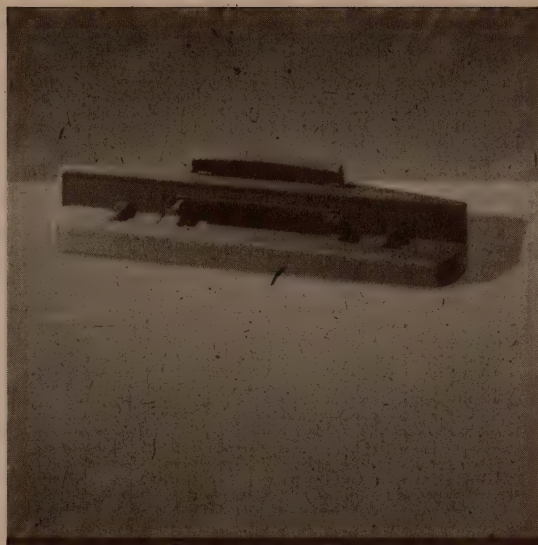5. Replace the NuBus card guide.

Figure 5   NuBus Card Installation

Macintosh
Duo MiniDock

Top Cover

Mechanical Latch Assembly

Modem Interface Card

Logic Board

Bottom Cover Assembly

Figure 1 . Macintosh Duo MiniDock Exploded View

Bottom cover w/ insulator 815-1263
   Insulator 922-0114
   Screw kit, Duo MiniDock..076-0111
Logic board 661-1664
Mechanical latch assembly...922-0103
   Link 815-1265
Modem interface card, domestic..922-0095
Modem interface card, international 922-0094
Top cover...815-1262

Specifications

Processor	Addressing: 32-bit internal registers; 32-bit address bus; 32-bit data bus
Memory	VRAM: 512K; supports all Macintosh monitors up to 16-in. color; supports some VGA monitors (requires adapter and NuBus card); supports 256 colors or shades of gray
I/O Interfaces	Docking connector: Internal, 152-pin PDS connector to PowerBook Duo 210/230 Serial: Two RS-422 serial ports; mini DIN-8 connectors ADB: ADB port (recommended max. of three low-speed, synchronous ADB devices); mini DIN-4 connector; 200 mA max. current draw for all ADB devices SCSI: HDI-30 SCSI port with 1.5 MB/sec. transfer rate; supports max. of five devices; includes built-in terminator; connection to another computer requires HDI-30 SCSI system cable Floppy drive: HDI-20 port for external 1.4 MB floppy drive (MS-DOS compatible) Video: DB-15 connector supports Macintosh and VGA monitors (requires 15-pin to VGA adapter) Sound: Monaural sound-in port (requires 20 dB attenuation cables and adapters to accommodate audio equipment with line level outputs; monaural sound-output port for external audio amplifier Modem: Pass-through telephone jack for optional internal PowerBook Express modem (RJ-11 domestic; mini DIN-8 international)
Electrical	Power supply: Universal AC power supply, 85–270 VAC; 47–63 Hz single phase input line frequency
Physical	Height: 2.1 in. (53 mm) Width: 10.6 in. (269 mm) Depth: 3.2 in. (81 mm) Weight: 1.24 lb. (.56 kg)
Environmental	Operating temperature: 50–104° F (10–40° C) Storage temperature: -40 to 116° F (-40 to 47° C) Relative humidity: 20–95% noncondensing Altitude: 0–15,000 ft (0–4722 m)
Options	Slot for security cable; modem expander (domestic or international telephone jack)

Symptom/Cure Chart

Startup Problems	Solutions
RAM failure occurs (eight-tone error chord sounds after startup chord)	1. Disconnect Duo MiniDock from PowerBook Duo 210/230. Reboot and troubleshoot computer only. 2. Replace Duo MiniDock logic board.
Hardware failure occurs (four-tone error chord sounds after startup chord)	1. Disconnect Duo MiniDock from PowerBook Duo 210/230. Reboot and troubleshoot computer only. 2. Replace Duo MiniDock logic board.

Power Problems	Solutions
System doesn't respond	1. Disconnect Duo MiniDock from PowerBook 210/230. Reboot and troubleshoot computer only. 2. Check all Duo MiniDock logic board cable connections. 3. Replace Duo MiniDock logic board.
System intermittently crashes or locks up	1. Verify that System is 7.1 or higher. 2. Verify that you are using known-good software. 3. Disconnect Duo MiniDock from PowerBook 210/230. Reboot and troubleshoot computer only. 4. Replace Duo MiniDock logic board.

Video Problems	Solutions
No external display, but computer appears to operate correctly	1. Adjust screen contrast. 2. Reseat video cable. 3. Replace video cable. 4. Try known-good external display. If now OK, replace and troubleshoot original display. 5. Replace Duo MiniDock logic board.
Raster or video display problems at external monitor	1. Reseat video cable. 2. Replace video cable. 3. Try known good external display. If now OK, replace and troubleshoot original display. 4. Replace Duo MiniDock logic board.

Floppy Drive Problems	Solutions
Audio and video present, but external floppy drive doesn't operate	1. Try known-good floppy disk. 2. Check floppy drive cable connection. 3. Replace floppy drive cable. 4. Replace floppy drive. 5. Replace Duo MiniDock logic board.

Disk ejects while booting; display shows Mac icon with blinking "X"	1. Try known-good system disk. 2. Verify that mouse or trackball button is not stuck. 3. Check floppy drive cable connection. 4. Replace floppy drive cable. 5. Replace floppy drive. 6. Replace Duo MiniDock logic board.
Disk doesn't eject	1. Switch off system. To eject disk, hold mouse or trackball button down while you switch system on. 2. Insert straightened paper clip into hole next to drive opening and eject disk. 3. Check floppy drive cable connection. 4. Replace floppy drive cable. 5. Replace floppy drive. 6. Replace Duo MiniDock logic board.
Disk initialization fails	1. Verify that you are using correct media. 2. Try known-good floppy disk. 3. Check floppy drive cable connection. 4. Replace floppy drive cable. 5. Replace floppy drive.
Read/write/copy error	1. Verify that you are using correct media. 2. Try known-good floppy disk. 3. Check floppy drive cable connection. 4. Replace floppy drive cable. 5. Replace floppy drive.

Hard Drive Problems | **Solutions**

Internal PowerBook hard drive doesn't operate	– Disconnect Duo MiniDock from PowerBook 210/230. Reboot and troubleshoot computer only.
External hard drive doesn't operate	1. Check hard drive cable connection 2. Replace hard drive cable. 3. Run *Macintosh Hard Disk Test*. 4. Use *HD SC Setup* to reinitialize drive. 5. Replace hard drive. 6. Replace Duo MiniDock logic board.
Drive doesn't appear on desktop	1. Restart system. 2. Verify that SCSI devices have unique addresses. 3. Use *HD SC Setup* to initialize drive.

Peripheral Problems | **Solutions**

Cursor doesn't
move, or moves
erratically

1. Simultaneously press <Command> <Control> <Power On> keys to reset computer.
2. Check ADB connections.
3. Inspect and clean mouse, if necessary.
4. If mouse was connected to keyboard, try in ADB port. If OK, replace keyboard.
5. Replace mouse.
6. Replace Duo MiniDock logic board.

Cursor moves, but
clicking mouse button
has no effect

1. Replace mouse.
2. Replace Duo MiniDock logic board.

No response
to any key on
keyboard

1. Press <Power On> key or power button.
2. Check keyboard cable connection.
3. Replace keyboard cable.
4. Replace keyboard.
5. Replace Duo MiniDock logic board.

Can't double-
click to open
application,
disk, or server

1. Remove any multiple system files.
2. Inspect and clean mouse, if necessary.
3. Clear parameter RAM. Hold down <Shift> <Option> <P> <R> during startup but before "Welcome to Macintosh" appears.
4. If mouse was connected to keyboard, try mouse in ADB port. If OK, replace keyboard.
5. Replace mouse.
6. Replace Duo MiniDock logic board.

After you connect
external SCSI
device, computer
doesn't boot

1. Switch on external SCSI device before starting computer.
2. Check cable connections.
3. Verify that standard Apple terminator terminates SCSI chain.
4. Verify that SCSI select switch setting on external device is unique.
5. Try known-good external SCSI device.
6. Replace Duo MiniDock logic board.

Known-good
ImageWriter,
ImageWriter II,
or LQ doesn't
print

1. Verify that System is 7.1 or later.
2. Verify that Chooser and Control Panel settings are correct.
3. Check cables.
4. Replace printer interface cable.
5. Try known-good printer.
6. Replace Duo MiniDock logic board.

Known-good
LaserWriter
doesn't print

1. Verify that System is 7.1 or later.
2. Verify that Chooser and Control Panel settings are correct.
3. Check cables.
4. Replace printer interface cable.
5. Try known-good printer. If printer works, troubleshoot network. Refer to Networks manual on *Service Source*.
6. Replace Duo MiniDock logic board.

Device connected to external modem port doesn't work	1. Verify that External Modem is selected in Control Panel.
	2. Verify that System is 7.1 or later.
	3. Check cables.
	4. Test device with known-good computer.
	5. Disconnect Duo MiniDock from PowerBook and test device at PowerBook external modem/printer port.
	6. Replace Duo MiniDock modem interface card.
	7. Replace Duo MiniDock logic board.
I/O devices are unrecognized or garbage is transmitted or received	1. Verify that System is 7.1 or later.
	2. Check cables.
	3. Verify that SCSI devices are terminated properly.
	4. Verify that SCSI select switch setting on external device is unique and between 2 and 6.
	5. Test device with known-good computer.
	6. Replace Duo MiniDock logic board.

Internal Modem Problems   **Solutions**

Internal modem options don't appear in CDEV	1. Verify that System is 7.1 or later.
	2. Remove and reseat modem interface board.
	3. Disconnect Duo MiniDock from PowerBook and test PowerBook internal modem.
	4. Replace modem interface board.
	5. Replace Duo MiniDock logic board.
Modem doesn't respond properly to AT command set instructions	1. Verify that baud rate and data format settings of communications application are compatible with internal modem and remote modem.
	2. Check phone cord connection and operation.
	3. Verify that System is 7.1 or later.
	4. Remove and reseat modem interface board.
	5. Disconnect Duo MiniDock from PowerBook and test PowerBook internal modem.
	6. Replace modem interface board.
	7. Replace Duo MiniDock logic board.
Strange mix of characters appears on screen	1. Verify that baud rate and data format settings of communications application are compatible with internal modem and remote modem.
	2. Check phone cord connection and operation.
	3. Verify that System is 7.1 or later.
	4. Remove and reseat modem interface board.
	5. Disconnect Duo MiniDock from PowerBook and test PowerBook internal modem.
	6. Replace modem interface board.
	7. Replace Duo MiniDock logic board.

Modem interferes with system sound	1. Remove and reseat modem interface board.
	2. Disconnect Duo MiniDock from PowerBook and test PowerBook internal modem.
	3. Replace modem interface board.
	4. Replace Duo MiniDock logic board.

Modem doesn't respond to incoming call	1. If computer is in sleep mode, verify that **Answer Calls** is selected in Remote Access Setup control panel.
	2. Check phone cord connection and operation.
	3. Disconnect Duo MiniDock from PowerBook and test PowerBook internal modem.
	4. Replace modem interface board.
	5. Replace Duo MiniDock logic board.

Modem has no sound output	1. Verify that Control Panel volume setting is 1 or higher.
	2. Disconnect Duo MiniDock from PowerBook and test PowerBook internal modem.
	3. Replace modem interface board.
	4. Replace Duo MiniDock logic board.

| Modem connects but doesn't communicate with remote modem | 1. Verify that remote modem needs error correction (error correction is internal modem default). |
| | 2. Type **AT &Q0** to disable error correction. |

Miscellaneous Problems   **Solutions**

Can't connect/ disconnect MiniDock   — Replace mechanical latch.

Modem Interface Card

The modem interface card provides telephone line interface (DAA) circuitry for PowerBook Duo 210 and 230 computers with an internal modem. To address the differences in telephone interfaces and specifications, Apple provides both domestic and international versions of this card.

To install or remove a model interface card, you will need a T-6 Torx driver.

Caution   **The Macintosh Duo MiniDock contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap and review the ESD precautions.**

1. Remove the top cover, mechanical latch, and logic board.
2. Connect the modem interface card to logic board connector J6.
3. In Japan only, install a jumper on the modem interface card connector J3. (A jumper is included with every modem interface card.)
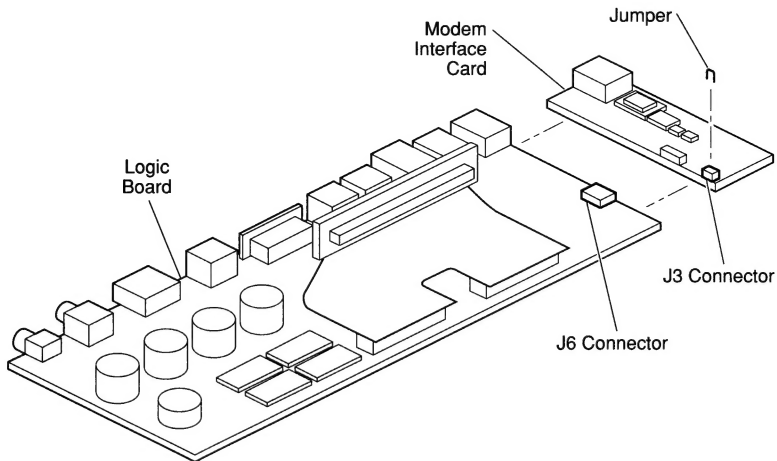
Figure 2   Modem Interface Card Installation